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"*To the solid ground*
Of Nature trusts the mind that builds for aye."—WORDSWORTH

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NATURE

A WEEKLY JOURNAL OF SCIENCE

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SATURDAY, JANUARY 4, 1930

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Science and Administration

IN several recent pronouncements relating to widely different fields which touch administration the importance of the acquisition of scientific knowledge and of the adoption of scientific methods have been strongly emphasised

On Nov 30, in the course of the Sidgwick Memorial Lecture on "Democracy", delivered by him at Cambridge, General Smuts directed attention to the fact that science is necessary to the modern State and should have its functional relation to the State, he stressed the point that to-day not only is a scientific spirit needed in human affairs, but also that above all it is this spirit which is called for in the administration of human affairs A few days previously, dealing with matters relating to a narrower field, the Secretary of State for the Colonies sounded a similar note when paying a tribute to the value of anthropology in the administration of the affairs of a backward people, he urged the importance of the acquisition of a knowledge of this branch of science by young men proceeding to British Dependencies to take part in administrative work

Again, there has just been published the valuable Interim Report of the Committee on Education for Salesmanship (H M S O, price 4*d*) Salesmanship is, as this Committee understands the term, "a prime function of direction and supreme management" and "embraces the study of the fundamental principles of commerce and the planning of policy based upon them" Consequently, the matters discussed in this Report cover an important area of the administrative field in commerce, where weakness has been shown to exist in this field it has been traced to "a detached and insular attitude

and unscientific practice" on the part of our business community Not only does this Committee recommend that a "scientific study" should be undertaken of our commercial problems, but it also states that "the evidence of the Associated Chambers of Commerce emphasises the absolute necessity of expert knowledge by the salesman of goods of a technical description"

However, it is apparent that the views of the Associated Chambers of Commerce are not universally accepted in commercial circles, and that old time prejudices are still alive therein In some quarters, the view continues to be held that "too much knowledge may be a dangerous thing", the expert has not yet come into favour there Indeed, in such quarters, it is feared that in the field of salesmanship the technical dissertations of the expert may prove wearisome to the customer, and hence do more harm than good It is perhaps for this reason that another way of meeting the situation has been suggested It has been proposed to the Committee that where a machine, appliance, or article requiring specialist knowledge is being sold, the maker should attach his own expert to the staff of the agent, "so that the technical advice and service may be available on the spot" that is to say, it is seriously recommended that our manufacturers should employ two men to sell their products, where the shrewdest and most resolute of their foreign competitors employ but one, and that a highly qualified expert

In view of the foregoing proposal, it cannot be a matter for surprise that, in the course of the remarks which he recently addressed to business men at a meeting held in London, the president of the Canadian National Railways should have felt himself compelled to point out that if Great Britain is to recover its industrial pre eminence there must be an entire 'scrapping' of present day commercial policies, methods, machinery, and appliances with the object of reducing the costs of production—he might very appropriately have added and *above all of reducing the costs of distribution*

It is a general question which the foregoing pronouncements raise directly, namely, that relating to efficiency in administration and the best form of staff organisation by which it can be attained under modern conditions, whether in the public services, industry, or commerce Indirectly, these pronouncements point to the necessity for a thorough investigation into matters affecting the functions which should be assigned to the man of science and the technical expert, so that the boundaries of their spheres of responsibility may be readjusted with the view of meeting the new conditions which have arisen in all branches of human activity owing to the applications of science on every battle front

A study of administrative and management methods is a matter of supreme importance at the moment, because they are vital factors in the progress and welfare of our public services, which are increasing in many directions It must be remembered that for many decades now a gradual change has been taking place in the character of the ownership of our industrial and commercial undertakings With the growth in their size and the extension of their activities in relation both to the kind of business for which they are responsible and also the considerable area of the territory in which they often operate, individual and partnership ownership has been giving place to collective and corporate ownership Where undertakings and enterprises have been incorporated under the provisions of statutes they have, for practical purposes, lost the status of a private business, in the strict sense of the term, and have instead thereof become in effect public services Questions, therefore, affecting the methods of administration and the type of organisation adopted in them can no longer be considered to be merely matters of their own domestic concern questions in relation to their control and management possess for the public an importance to day which is only very slightly less than do questions connected with the similar aspects of administration bearing upon governmental and municipal activities and enterprises In this connexion it is interesting to note that very careful consideration has been given in Germany to the problems of management and organisation in the case of the State owned concerns which have been set up in that country since the termination of the War The significant fact stands out that the directors who have been appointed by the German Government to control and manage these concerns are men who have been selected for these positions from among those possessing *expert and specialised knowledge*, and have full executive authority within the limits of the general policy laid down The practice referred to provides a useful lesson and might with profit be imitated in Great Britain

There are signs that there is an awakening in Great Britain, and there exists a readiness on the part of progressively minded men to overhaul our old fashioned and out of-date methods and practices, In order to stimulate this feeling into action, it seems to be alone necessary for some authori-

tative body to set the ball rolling by indicating the nature of the reforms which will best suit the new conditions which have come into existence with the invasion of science into every domain of human affairs

The question which perhaps most immediately requires close and attentive examination is that connected with the proper constitution of the controlling bodies responsible for the management of government departments and of industrial and commercial undertakings and enterprises These bodies are sometimes appropriately referred to as the 'directive organ', and, as is well known, it is in them that reside the power and authority for deciding not only what shall be the character of the administrative methods and practices to be employed in the organisations for which they are responsible, but they have also the final word on questions of even greater importance, affecting, as they do, the whole well being and success in every sphere in which combinations of knowledge and effort are required, namely, on questions relating to the recruitment of the staff On these rests the ultimate responsibility for determining what type of men shall be selected for particular positions, technical as well as administrative, and also what shall be the character of the qualifications which shall be sought for in the various classes of officials

Non technical administrators and directors cannot, obviously, be so well equipped for dealing with problems of the kinds referred to above as those who have been 'through the mill', and, owing to their scientific and technical training and practical experience, have therefore acquired an intimate personal knowledge of all the essential factors which are severally involved in the solution of particular problems coming under their jurisdiction, and, what is equally important, as to the nature of the qualifications required in those to whom should be entrusted the duty of providing the most satisfactory solution of any particular problem Hitherto, a disinclination has existed in Great Britain to give men with scientific and technical qualifications—and also possessing other essential qualifications—seats on boards of directors, or to appoint them to the more important administrative positions

The crippling influence of the harmful traditions and prejudices associated with a narrow policy of the kind here indicated requires to be got rid of, only if a change of spirit can be brought about in this matter is there any likelihood of effecting a real improvement in matters of the deepest concern to the nation Desirable economies and other beneficial results would follow suitable reforms carried out in the administrative sphere, they can alone be secured by widening the scope of responsibility of the man of science and the technologists It is essential that in the case of every 'directive organ' a due proportion of those forming it shall be men possessing scientific knowledge and technical experience, and further, that men with the qualifications here indicated shall be chosen more frequently than in the past for responsible administrative posts

It has been suggested that the failure in the past to employ, to a sufficient extent, men of science and technologists in the directive and administrative spheres may have been due to the reluctance that these types of men have shown to undertake work in those spheres, or possibly to the absence of aggressiveness on their part in seeking for positions therein If this has been the case, it is imperative in the national interest that such reluctance or passivity should be overcome by them they should pay heed to the exhortation of Sir William Bragg, who, on the occasion of the opening of the new science building of St Edward's School, Oxford (on Dec 8), made a pointed reference to the needs of the day in the following terms "There is a certain type of man who is badly wanted in this country at this moment It is the scientific man who is also an administrator We need men to day who are not merely scientists, but who are also willing to take responsibility, to mix in the affairs of men, and to know something of the world"

There is another and an exceedingly important reason why men of science and technologists should play a larger and more important part than in the past in the directive and administrative spheres of responsibility It is recognised by many who have studied the problem that one of the most pressing requirements of the day is that of narrowing the zone of separation between the workmen on one hand and those responsible for the directive and administrative aspects of the work on the other Attempts have been made to secure this end In the governmental sphere officers of the administrative branch have in some cases established direct contact with the workers, and in some industrial enterprises committees of directors have been appointed to preside over departmental operations

However, there is evidence that the results in such cases have not been altogether happy Non technical administrative officers cannot hope to, and, as a rule, do not, hold their own in arguments

exchanged with workers in a technical field, and in these discussions there is often an unwillingness on their part to admit the errors in their views, and this necessarily still further strains the relations between these two groups instead of improving them, the workers naturally derive small comfort when, having got the best of an argument, they are told 'But there is no logic in administration' Similarly, interference with details of departmental operations by directors, particularly on the part of those who have no technical knowledge, can but be, and, indeed, has proved to be, harmful, it leads in the long run to inefficiency and loss In situations of the kind referred to, experienced technical men would carefully avoid saying or doing anything mischievous

Obviously, it is practically impossible to secure a proper bond of sympathy between the two groups, the directive and the workers, under modern conditions, where the control and management are vested entirely in the hands of non-technical men who are either ignorant of technical considerations or act without regard to them On the other hand, there is every reason for supposing that the risks of misunderstandings between the several groups in an organisation would be reduced to vanishing point were technical experts who have prepared themselves for the rôle called upon to play a more prominent part than hitherto in the directive and administrative spheres It is the development of a policy to secure these ends that will provide what is so essential to day a strong and effective link between science and administration

History of Science

A History of Science and its Relations with Philosophy and Religion By William Cecil Dampier Dampier-Whetham Pp xxi + 514 (Cambridge At the University Press, 1929) 18s net

MR DAMPIER-WHETHAM, in writing a general history of science, has undertaken what is, strictly, an impossible task It is therefore very easy for any critic who cares to spend a day or two in a library to that end to pick holes in matters of detail Taking the book as a whole, as in the first instance it should be, it is a fine and bold piece of work The narrative is always clear and concise and the sequence orderly, it never degenerates into the dismal catalogue of names and dates which sometimes masquerades as the history of science The mutual relations between scientific discovery and other phases of contemporary thought are generally well brought out, particularly the relations between science and philosophy

For the early history of science Mr Dampier-Whetham is in a more favourable position than his predecessor Whewell, thanks to the recent labours of scholars who have worked out special developments in special periods But for the later history the task is much harder than in Whewell's time, when physics seemed to be advancing quietly and steadily on proved foundations and biology scarcely existed Up to the end of the nineteenth century, discoveries and developments of thought can still be seen in perspective in relation to what came before and has come after, the wood can be distinguished from the trees It is when the present century comes under review that the historian's task becomes really alarming because of the abundance and confusion of material Yet the historian cannot stop earlier than the present day without cheating the reader of the most interesting part of the story It is significant that 105 pages suffice for all the time before the fifteenth century, from the fifteenth to the end of the eighteenth, 111 pages, 130 pages for nineteenth century, while 150 are devoted to the present century This division not unfairly represents the rate of advance

Modern developments in physics are well and simply described The story is of course the most exciting episode in the whole history of science It seems at the moment as though the three main lines of modern research, field physics, atomic structure, and cosmogony, are all tending towards a final synthesis which will lay bare the ultimate nature of the physical universe We can all hear the mathematical hounds in full cry, and even as we run panting far in the rear, can share in the excitement of the chase But with all the excitement it is hard to suppress a haunting fear that the end of this hunt may be like that of the 'Hunting of the Snark' However this may be, the history of modern physics can be made intelligible, the task needs knowledge and skill but is not impossible, for certain main lines of advance are clearly marked out It is when the other sciences come to be considered that the historian's task becomes really impossible There is at present abundant activity in detail, but there are no clear lines of advance, so that we can only guess which discoveries are the important and fruitful ones and which are destined to be sterile, though at the moment they may loom large The writer is bound to be guided by his interests and prejudices, and the reader in his turn will approve or disapprove according to

whether his own interests and prejudices coincide or not. A few examples will illustrate the difficulties.

The author does not mention chemistry, apart from its biological applications, in his review of the present century. This omission will undoubtedly offend the chemists, but I believe it to be reasonable. Twentieth century chemistry has been concerned with the use of nineteenth century methods for the application and development of nineteenth century theory. New methods and new theories have been left in the hands of the physicists. On the other hand, I should be inclined to dispute the prominent place given in the section on physiology to the recent work on hormones and vitamins. It is true the results are striking and have caught the public eye; nevertheless, there is reason to think that the ideas involved are too crude to have a permanent place in scientific thought and that existing methods of investigation are also very crude relative to the problems. It is pioneer and not classical work. Future generations will probably extend to present-day notions the same pitying tolerance we extend to the notions of 'caloric' and 'phlogiston'. In contrast with this work, I believe the work of Sherrington and his school, which is no more than mentioned, to be classical. Sherrington's methods are completely adequate for his purpose, and his ideas, though clothed in difficult language, are both simple and subtle. These ideas now dominate the physiology of the central nervous system and are likely to do so for a long time to come; the subject, moreover, is the central or key subject of the whole of physiology. This, of course, is a personal opinion; it is introduced merely to emphasise the extreme difficulty of dealing historically with modern work. Not only is an incredible diligence in accumulating detailed knowledge needed, but also superhuman powers of criticism and prophecy. In parenthesis, it seems necessary to protest against the omission of Sorensen's name from the paragraphs on colloid chemistry and ionic equilibria.

The author is to be congratulated on including a survey of those subjects, embryonic perhaps but still sciences, that lie on the borders of the physical sciences, such as psychology and anthropology. His choice of subjects and the views he expresses on certain controversial topics will be objected to by many, but in these regions controversy cannot be avoided except by silence.

There is one aspect of the history of science which is strangely neglected in this book as in others, but which is not without interest; that is, the effect of practical human needs on the course of scientific discovery. A few examples will make my meaning clear: first a minor one and then two more speculative but more important cases. It is a commonplace that the progress of physics depends upon the design and use of instruments of precision. But apparently no physicist realised either the possibility or the value of galvanometers for measuring small currents until Kelvin devised his mirror galvanometer in response to a purely practical demand, namely, for use with the trans-Atlantic cable when existing telegraphic methods had failed. Once the instrument was made, it was quickly applied to laboratory purposes, and innumerable discoveries have been made with it and its successors. Of course, the development would ultimately have taken place, as would the theory of gravitation without Newton, but it would have been delayed. Given an instrument or method, scientific men are quick to apply it to existing problems, but the existence of a problem does not always call forth a method for solving it; the method may come from some quite unexpected quarter.

The second example is the peculiar position that medicine occupied in the early stages of scientific discovery. As Mr. Dampier Whetham points out, the enormous success of geometry, which seemed to provide a means for obtaining genuine knowledge about the external world by *a priori* methods, blinded the Greeks (and many others until recent times) to the necessity of observation and experiment. Even apart from this, it seems that human beings are naturally reluctant to start the labour of accurate and disinterested observation. Once a start has been made, the work may be found interesting for its own sake, but some powerful ulterior motive is generally needed at the beginning. In the ancient world the desire to cure disease, in spite of the hocus pocus that always surrounds the practice of medicine, seemed to provide one of the few motives for precise observation. The best of the Greek medical workers realised that for their purpose *a priori* reasoning led nowhere and only the slow method of observation was any use. In this way were laid the foundations not only of human anatomy and physiology, but also of zoology and botany (it must be remembered that Aristotle was the son of a physician before he was a pupil of Plato), and in later times of chemistry. It is remarkable that while medicine and the studies underlying it were well launched on their scientific career, agriculture still remained for centuries dependent on tradition and superstition, as though hunger was a less powerful motive for research

than compassion Perhaps it is nearer the truth to say that the stomachs of the intelligentsia have usually been sufficiently well filled to turn their thoughts away from such gross considerations as food supply But they could not shut their eyes to disease and death, which might come to anyone at any time

Lastly, consider the case of astronomical observation The astronomical observations of the Babylonians and Egyptians were dictated by practical considerations, for determining the seasons and for astrological prediction Astrology was still a leading motive for astronomical observation almost until modern times The Greeks, who were free from the superstitious motive, seem to have done little in the way of observation Their contributions were of unique value but were theoretical — the application of mathematics to astronomy and the rudiments of a ' mécanique céleste ' But from the fifteenth century onwards there was a new stimulus to observation with more exacting requirements this again was a practical need—the art of navigation For casting a horoscope it was useful to have numerous observations, but they did not need to be precise, the seaman was not so easily satisfied What is most characteristic of modern physics is the design and use of instruments of precision and exact numerical calculation for purposes of prediction These characteristics first appeared in connexion with the compilation of the "Nautical Almanac" and map making Greenwich Observatory was founded for this purpose More than two centuries earlier, before western Europe had made any contributions to science, Prince Henry the Navigator had founded at Sagres the very first school of technology

There is another aspect of the voyages of discovery of the fifteenth and sixteenth centuries, a result this time that seems to deserve more notice than it usually gets from the historian of science Mr Dampier Whetham emphasises the fact that at this period the early men of science had to rid themselves of the incubus of the medieval outlook, an incubus from which the Greeks were mercifully free He does not, however, mention what was possibly the greatest single factor in the process of liberation, the discovery of the New World and the circumnavigation of the globe These facts proved, in a way which the most thick-headed were compelled to understand, that the traditional cosmology was not infallible, that ancient authorities could be wrong, and that even the thunders of the Vatican could not put Humpty Dumpty together again

A D RITCHIE

Man's Ancestry

Man's Place among the Mammals By Prof Frederic Wood Jones Pp xi + 372 + 12 plates (London Edward Arnold and Co, 1929) 21s net

EARLY in 1918, Prof F Wood Jones gave a popular lecture in King's College, London, on man's origin This lecture, when published by the Society for Promoting Christian Knowledge under the title "The Problem of Man's Ancestry", met with a mixed reception Anatomists treated it with neglect or contempt, those of an anti Darwinian bias hailed it with delight As the little book of 1918 is really the parent of the large work which has just appeared under the title "Man's Place among the Mammals", it is worth while to seek for an explanation of the diversity of feeling evoked by the original publication The antagonistic attitude of most anatomists is understandable They were told that man, far from being as they thought the most changed, the most specialised, the most highly evolved of all primate animals was, when his structural characters were rightly analysed, essentially a very ancient and primitive type They learned that they had laboured in vain, because in construing the evidence relating to man's origin they had been dominated by a heresy for which Darwin, Huxley, and Haeckel were conjointly responsible, namely, that there had been an anthropoidal stage in man's evolution Prof Wood Jones summarily dismissed the anthropoids living and extinct, at no time had they any lot or part in man's ancestry

The opposition offered to this thesis by anatomists can be understood, but the welcome extended to it by those of a ' fundamentalist ' turn of mind is less easily accounted for Prof Wood Jones is a convinced evolutionist, man, he declares, has been evolved, but not from an anthropoidal form He contends now, as he did in 1918, that man's independent origin has to be sought for among the small Tarsioids which appeared during the Eocene period of the earth's history It may seem to the ordinary reader that it matters little whether we include or exclude anthropoids from man's ancestry, but at the conclusion of his original lecture Prof Wood Jones made clear to his audience that a deep ethical significance was involved He said

"Were man to regard himself as being an extremely ancient type, distinguished now, and differentiated in the past, purely by the qualities of his mind, and were he to regard existing Primates as misguided and degenerated failures of this ancient stock, I

think it would be something gained for the ethical outlook of humanity—and it would be a belief consistent with present knowledge"

Herein I think Prof Wood Jones reflects unfairly on anthropoid apes Prof Elliot Smith is convinced of man's anthropoid ancestry, and yet he finds that natural man is peace loving and virtuous

The lecture of 1918 was prepared and delivered in a war atmosphere No doubt the author suffered unfairly from the fact that he was unable in the course of a brief hour to deal fully with the proofs which his critics expected him to produce He has now had ample opportunities of meeting the demands of his critics In a series of forty brief chapters, brilliantly written, illustrated by his own excellent drawings and illuminated by happy touches which reveal the author as naturalist as well as anatomist, he expounds his conception not only of man's place among mammals, but also the places which should be given to Lemurs, the Tarsiers, monkeys of the New World, monkeys of the Old World, and to anthropoid apes, both great and small It is not until we reach the thirty eighth chapter that we find what we have been waiting for—the author's conception of the evolutionary changes which converted a primitive small brained Tarsioid into a human being We particularly want to know how and when man's body underwent the structural revolution which fits it for an orthograde posture and for bipedal progression

It is just when he approaches these problems that our author, usually so precise and definite, becomes tantalisingly elusive and non committal We are told that the "proto human" stock was the first to break away from that line of Tarsioids which ultimately became separated into anthropoids and Old World monkeys Man's ancestry broke away while the basal phylum still retained all its 'primitive' features and was adapted in body and limb for life in the trees Having broken away, the proto humanoids took to walking on their hind limbs, and their bodies and feet underwent the structural revolution which fitted them for an upright posture and for bipedal progression Then the brain began to grow

"Everything would point to the fact that enlargement of the brain came in the proto human or progressive stock at a time when that stock was in possession of a very primitive type of cranium, and that enlargement of the brain case occurred at a stage in which no other evolutionary trends, save those of mere enlargement, had been initiated" (p 341)

It would be fair to presume from this statement that Prof Wood Jones attributes man's big brain to the fact that it began to grow when his skull was in a still plastic state A paragraph on another page, however (p 340), makes us hesitate in drawing this inference, for there we are informed that "Man enlarged his primitive chondrocranium by his early phylogenetic development of a large brain", here the large chondrocranium is attributed to the large brain Clearly, the explanation given by Prof Wood Jones of man's structural adaptation to bipedal progression and of his large brain cannot be regarded as satisfactory No evidence in support of such speculations is afforded by any fossil discovery made hitherto, still, as Prof Wood Jones rightly maintains, the geological records of man's evolution are still very imperfect

Having thus postulated an independent origin for man, Prof Wood Jones has to face a multitude of very difficult problems How are the long list of intimate structural resemblances which bind man to anthropoid apes to be explained? He admits these resemblances It must be realised at the outset", he writes, "that of all animals the giant apes show the nearest structural affinities with man This fact has always been realised, and it remains an uncontrovertible truth" He regards these resemblances not as an inheritance which man and anthropoid have derived from a common ancestor, but as independent acquisitions Now, in the order of Primates we do meet with surprising and definite examples of parallel or convergent evolution Nevertheless, Prof Wood Jones under estimates and under states the many and intimate structural and biological resemblances which link man to the great anthropoids He has to presume that man and anthropoids came independently by the same form of uterus, the same elaborate process of placentation, the same tendency to prolong the fœtal and infantile periods of growth and development He attempts to minimise the resemblance of the anthropoid brain to the human brain, if we did not know of the stage of evolution represented by the anthropoid brain, we should have to presume its existence, without such a presumption, it would be impossible to explain how the small and simple brain of a Tarsioid could become transformed into the elaborate brain of man

Every bone and muscle of man's body have undergone profound structural alterations to fit him to his orthograde posture The same bones and muscles have undergone similar changes in anthropoids, but to a less degree If we suppose that adaptation to an orthograde posture is a common inheritance, then we get light on how man came by his postural adaptation, for in their bodies anthropoid apes preserve stages which lead towards

the specialisations found in the human body Our author rejects such an interpretation, he supposes that man and anthropoids have independently acquired their orthograde posture, and in the process of evolution come by the same structural modifications He regards all such postural modifications as 'adaptations', and therefore useless as indications of relationship Relationship, he holds, must be determined on inborn, non adaptative structural characters He gives lists of such characters, but a careful analysis of his lists reveals the fact that the structures cited are those the functional significance of which is not apparent Is there any structure in the animal body which is devoid of functional significance and therefore free from adaptative changes?

The truth of a hypothesis is measured by the ease and naturalness with which it explains the multitude of facts which lie within a field of investigation When Prof Wood Jones rejects an anthropoidal stage in man's ancestry, he has to explain away a tremendous number of facts That the blood of man and anthropoids gives the same reactions when submitted to similar tests our author admits, but denies that similarity of reaction indicates a true 'blood relationship' of man to anthropoid Man and anthropoids have very similar susceptibilities to disease—a fact which is not discussed In recent years the existence of 'blood groups' has been demonstrated in all races of mankind The only other animals which possess corresponding group reactions are the anthropoid apes[1] Prof and Mrs Yerkes, in the great monograph recently published on "The Great Apes", demonstrate that of all animals the mental reactions of the great anthropoids are the nearest to those of man All these facts Prof Wood Jones has to explain away He has also to meet the fact that the further we trace man backwards in time, the more accentuated do his anthropoid characters become The skull cap of *Pithecanthropus* has been mistaken for that of a large gibbon, the lower jaw of Piltdown man had been claimed to be that of a chimpanzee, the molar teeth of Neanderthal man reproduces the dental pattern of the extinct anthropoid *Dryopithecus*, Rhodesian man rivalled the gorilla in the development of his supra orbital ridges All these facts run counter to Prof Wood Jones's scheme of man's evolution

The main criticism which must be made of this work is that it is not a full or fair statement of the great mass of evidence now available for determining man's evolutionary history and his relationship to anthropoid apes Nevertheless, it is a brilliantly written book, one which will serve a great and useful purpose in stimulating profitable discussion and further research A KEITH

[1] See "Anthropology and Blood Grouping", by Profs Woollard and Cleland *Man*, 1929. Vol 29, p 181

Geology of Albania

Geologica Hungarica Fasciculi ad illustrandam notionem Geologicam et Palaeontologicam Regni Hungariae Series Geologica, Tomus 3 Geographie und Geologie Nordalbaniens, von Baron Fr Nopcsa, mit einem Anhange von H v Mžik Beitrage zur Kartographie Albaniens nach orientalischen Quellen Pp xiv + 703 + 35 Tafeln (Budapestini Edidit Institutum Regni Hungariae Geologicum, 1929)

NORTHERN Albania is a complex mountainous area which rises above the eastern coast of the Adriatic, where it bends abruptly from its course from north west to south east parallel to the grain of the country, and runs south, cutting across both the strike of the rocks and of the mountains Northern Albania occupies a critical position in the geology and geography of the eastern borderlands of the Adriatic and of the much debated Dinaric Mountains The geology of the country, according to the first accounts, appeared perplexing owing to the puzzling sequence of the rocks, which has now been explained by Baron Nopcsa, after field work extending from 1905 to 1925, as due to great overthrusts This view he has now established in a ponderous monograph, which is published as the third volume of 'Geologica Hungarica" by the Geological Survey of Hungary, of which the author was until recently the Director The most important previous contributions were those of Cvijic, whose work is dealt with briefly, and one of his misunderstandings is described as "catastrophal"

The oldest rocks in northern Albania are the Upper Carboniferous, as during all the preceding part of the Palæozoic, Albania was included in a great South Balkan land which was traversed by ancient mountains trending east and west This influence is still seen in the maintenance of that direction by some of the ranges and by the Curzola Lesina archipelago in the Adriatic The description of this land begins with the Upper Carboniferous, as marine rocks of that date occur on the North Albanian block (or Tafel) These beds are shown to be Uralian by their fossils, for example, *Productus cora* and *P uralicus*, and they are followed by Permian Neoschwagerina limestones. The Trias

was marked by a wide extension of the sea, and the deposition of dolomitic and massive limestones ranging from the bottom of the Trias to the Rhætic, these limestones are well represented in both the North Albanian block and the Cukali mountain complex to the south In the Ladinian (Middle Trias), volcanoes discharged sheets of tuff, a material which is now jasper, and ophiolites, which are well known from Steinmann's view of their formation by abyssal eruptions

The Jurassic is less well developed owing to extensive earth movements In the Lias, marine limestones and marls were deposited over much of the country, and after a break in the Middle Jurassic, more limestones were formed in the Upper Jurassic on the North Albanian block, and red flaggy limestones and radiolarite in Cukali In the south eastern part of the area the Jurassic is doubtfully represented by the basic igneous rocks which range from serpentine and peridotites to diabase, and cover most of the Merdita overthrust sheet

The Cretaceous is represented in the North Albanian block by massive limestones, but land still lay close on the south, for the system begins in the Merdita with a basal conglomerate, followed by sandstones and shales, and later, owing to the widening subsidence, by flaggy limestones and the massive Hippuritic limestones, which extend throughout North Albania

At the end of the Cretaceous further earth movements reversed the conditions In the Eocene the clearer sea lay to the south and south west, for the coastal ranges are formed of Nummulitic limestone, while in the North Albanian block are shales with fucoids and beds of flysch The coastal hills contain Oligocene conglomerates, with granite pebbles from the east, and clays with corals Then follows an important gap, and the presence in the mountains of highly disturbed Oligocene beds and of undisturbed Lower Pliocene shows that the main Dinaric folding was in the Miocene It extended the South Balkan land, which was reduced in the Pleistocene by widespread subsidences in some places to the amount of thousands of feet These movements broke up the land between Greece and Asia Minor into the Ægean Archipelago, enlarged the Adriatic, and produced the poljes in the Dinaric Mountains and the fiords on the Dalmatian coast

In a volume, "The Nature and Origin of Fiords" (1913), I described the adjacent parts of the Adriatic coastlands as a fractured belt, and interpreted most of the basins or 'poljes' as due to subsidence along faults, and claimed the Gulf of Cattaro as a true fault-formed fiord This conclusion was supported by a photograph (*op cit* Pl vi) of the block opposite Cattaro, which was described as of a fault-block, from evidence seen in a surreptitious visit, as the front of it was closed by military regulations This explanation has been denied, and the Gulf claimed as due to normal erosion Baron Nopcsa, however, marks a great fault along the very line shown in my illustration He fully proves the tectonic origin of many of the poljes and of features along this coast, and says that the faults are of such recent origin that the fault scarps are in many places very little worn

The Pliocene beds include in southern Albania the huge bituminous limestones in the Voyusa valley, near Valona, which are worked for asphalt, and, in association with some traces of petroleum, have encouraged the hope that among the folds of the Dinaric limestones may be a still hidden oilfield

The volume contains a detailed description of the geography and geology of North Albania, with a coloured map on the scale of 1 to 200,000, numerous sketch maps and diagrams which illustrate the complex tectonics due to overthrusts generally from north east to south west The volume is well printed, and is accompanied by twenty five clearly explained photographs of the scenery and geological structures by a bibliography which deals with the literature on the Albanian problems in other parts of the Balkans and Asia Minor, and an article by Hans v Mžik on Oriental contributions to Albanian cartography

J W GREGORY

The Polarity of Molecules

Polar Molecules By Prof P Debye Pp 172 (New York The Chemical Catalog Co, Inc, 1929) 3 50 dollars

Polare Molekeln Von Prof P Debye Pp viii + 200 (Leipzig S Hirzel, 1929) 14 gold marks

THE name of Debye is associated with many new and important theories in physics, but none of his theories has more successfully suggested, directed, or stimulated experiment, than his theory of dielectrics Since Debye's first paper on this subject in 1912, so many advances have been made, and so many new facts established, that an authoritative account of these developments from the pen of Prof Debye himself is particularly welcome

The English book is the outcome of a recent visit of Prof Debye to America, where he gave courses of lectures on the dielectric properties of matter and was induced to put the substance of

his lectures in more permanent form The book is concerned principally with the molecular interpretation of the dielectric constant and the correlation of dielectric properties with other physical properties such as dispersion and absorption, particularly in the infra-red At present, theory can deal adequately only with vapours, because, in fluids, the interaction of neighbouring molecules is too important to be neglected and cannot be estimated Methods of dealing with dilute solutions have, however, been developed recently, and these are described in some detail

In the simple theory it is assumed that dielectric phenomena are due to two causes first, to the distortion of the electronic structure of the individual molecules in the presence of an electric field, and secondly, to the fact that the electrical distribution of many molecules is unsymmetrical even in the absence of a field, such molecules are said to possess a permanent electric moment The magnitude of this electric moment is a molecular constant, which is as important, if not more important than other known molecular constants such as the size of a molecule, as it exercises a controlling influence on many physical phenomena The methods of determining this constant by a comparison of theory and experiment are described at length and, for the first time, the magnitudes of all known electric moments are brought together in accessible form, in fact, the German book, which is a revised and extended edition of the English book, contains a list of the electric moments of about two hundred molecules This table is to be extended still further and issued later as a special supplement

The table of electric moments is instructive Molecules which consist of two different atoms are non symmetrical and possess a permanent moment, while molecules like hydrogen and nitrogen, which are symmetrical, have none Nearly all triatomic molecules have permanent moments, and this result leads to important deductions as to the arrangement of the atoms in a molecule It shows that the atoms of the water molecule, for example, cannot be situated symmetrically along a line A chapter is devoted to a discussion of the possible forms of this and other molecules, and it is shown that the arrangement of H_2O is most probably triangular, while that of NH_3 is pyramidal This conclusion will not surprise the organic chemist, as, on other grounds, he has long ago postulated that the three valencies of the nitrogen atom are not directed in a plane

Considerable work is now being done on the relation between the dissymmetry of molecules (as reflected in their electric moments) and their chemical formulæ Recent advances are reviewed in the English edition, and more fully in the later German edition The effect of the substitution of two equal molecular groups in a carbon chain or in the benzene molecule depends essentially on the relative positions of the groups The trans form of dichloroethylene and the para form of dinitrobenzene both have small or zero electric moments, but the unsymmetrical isomers have large moments If the two substituted groups are not equal, a moment remains even in the para-compound, as is illustrated by the three nitrotoluenes Appropriate measurements of the polarity can therefore be used to determine the electropositive and electronegative character of various molecular groups It seems likely that it will be possible soon to estimate the polarity of a complicated compound by adding up vectorially the moments of the different groups which constitute the molecule

The later chapters are devoted to an account of the new wave mechanics in so far as it affects the theory of the dielectric constant and the theory of dispersion The first formula given by Debye for the dielectric constant was deduced from the classical theory and had to be modified when the quantum theory was first introduced, but the more recent forms of the quantum theory, expressed by the matrix and wave mechanics, have returned the formula to its original form, so that the older determinations of electric moments deduced from the classical formula still stand The book concludes with a theoretical discussion of the dispersion and absorption of polar gases, with special reference to rotating molecules of the HCl type It is shown that anomalous dispersion should occur in the region of long wave lengths, approaching radio frequencies, though experimental results in this region are, of course, still lacking The notation used is unusual and unfortunate (the rotational quantum number, for example, being denoted by *n*) and might with advantage be brought into line with that already used in molecular spectra

This book not only brings together for the first time the accumulated information on electric dipoles, but also points out the gaps which still exist in theory and experiment It is thus of great value to all physicists and chemists who are interested in molecular structure, and, in suggesting new fields of work, is of the greatest possible value to research workers in this and allied subjects J E LENNARD-JONES

Our Bookshelf

(1) *The Future of the Earth* By Dr Harold Jeffreys (Psyche Miniatures General Series, No 24) Pp 72 (London Kegan Paul and Co, Ltd, 1929) 2s 6d net
(2) *Earthquakes and Volcanoes* By Prof J W Gregory (Benn's Sixpenny Library, No 97) Pp 80 (London Ernest Benn, Ltd, 1929) 6d
(3) *The Restless Earth An Introduction to the History of the Rocks* By Prof Herbert L Hawkins (Routledge Introductions to Modern Knowledge, No 10) Pp iv+76 (London George Routledge and Sons, Ltd, 1929) 6d net

THE first of these "little books on great subjects" is considerably shorter than the other two and costs five times as much But in view of the facts that it will appeal to a much smaller circle of readers, is well bound and is printed on good paper, it cannot be regarded as overpriced, it is rather the others that are extraordinarily cheap

(1) Dr Jeffreys entertainingly summarises some of the theories more technically discussed in his larger book, "The Earth" He deals with the history of the sun, and the age and origin of the solar system the cooling of the earth and the 50,000 million years of cooling still before it, and the past and future of the moon The title of the booklet indicates only a point of view

(2) Prof Gregory's contribution to Benn's inimitable Sixpenny Library is tightly packed with good things In eighteen short but intensely interesting chapters, he surveys every important aspect of volcanoes and earthquakes, and it is safe to say that there is no better short account of these subjects available in English The book should have a big sale, and its influence on teaching in schools, as well as directly on the reading public, should go far to remove many current misconceptions The chapter on "The Inner Structure of the Earth" is, however, less up to date than it might be, it is certainly not in accordance with modern evidence to describe the shell between the rocky crust and the iron nickel core as consisting "mainly of the rigid nickel iron mass of the earth" It is much more likely to have a composition akin to that of stony meteorites

(3) Prof Hawkins is not altogether happy as a popular writer, despite the attractive vitality of his style The use of metaphor and analogy is sometimes far fetched and undignified Denudation is "grinding the dust" the interior of the earth is "beneath the dust", earthquakes are "shivering fits", and volcanic activity is "feverishness" When the author writes 'the earth is bleeding to—perfection", or water is more obedient [than the wind] to the call of gravitation", he runs the risk of irritating some of his readers Apart from this occasional defect of manner, the matter of the book is excellent, and the name of the author is a sufficient guarantee of its trustworthiness as a popular introduction to geology

Royal Agricultural Society of England Agricultural Research in 1928 Pp viii + 193 (London John Murray, 1929) 1s

THE Royal Agricultural Society has issued its fourth annual summary entitled "Agricultural Research in 1928" As in previous years the publication is divided into a number of reports, each written by an acknowledged expert in the particular subject

Fruit and vegetable canning, though a comparatively new industry, appears to have made a promising start and should provide excellent new markets for farm produce provided suitable organisation, including standardisation and grading, is built up The importance of obtaining a full and even plant in cereals and sugar beet is emphasised if the best yields are to be secured

Progress is being made in the production of tuberculin free herds of dairy cows, and the importance of progeny rather than ancestral performance in estimating the worth of a breeding animal is becoming more clearly recognised Farm costings of all kinds, including questions concerning marketing and co operation, are being thoroughly investigated The effect of the Agricultural Credits Act on insurance and credit is also dealt with Among engineering problems, drainage is receiving considerable attention, and recent trials in other countries, notably France, are described Of the newer implements, the combine harvester seems to have proved its usefulness in the English climate, provided that a drier is regarded as a necessary part of the equipment Methods for drying grain, grass, and sugar beet are also being developed

No outstanding new discovery is mentioned in the animal nutrition section, but the most recent views as to the nutritive value of grass, sugar beet pulp and tops, silage, and milk are fully discussed As regards fertilisers, nitrogen occupies the most important position, its world production and consumption having enormously increased during 1927–1928 Potash, on the other hand, shows only a small increase over previous years, and phosphorus none at all The success of Danish agriculturists in the production of feeding stuffs is attributed to their large increase of acreage under root crops In England, on the other hand, the reverse is the case The major portion of the report on veterinary science deals with vaccination against tuberculosis, and it is shown that the different types of tubercle bacilli are capable of infecting species other than those from which they take their name To each report a large number of references are appended, and the publication should prove useful to farmers, agricultural organisers, and students

The Theory of the Gyroscopic Compass and its Deviations By Dr A L Rawlings Pp x + 191 (London Macmillan and Co, Ltd, 1929) 10s 6d net

IT was about eighty years ago that Foucault carried out his ingenious experiments with the gyroscope, but for half a century the apparatus had no practical application It has now, however, been applied

to the automatic steering of torpedoes, to the mono-rail car, to the reduction of the rolling of ships, and to the steering of ships Of the gyro scopic compasses now in use, the Anschutz was the first, and this was followed by the Sperry and Brown compasses H M S *Invincible* was navi gated to the Falkland Islands, and the British Submarine *E11* found her way up the Dardanelles into the Sea of Marmora, by Sperry compasses, and such compasses are to be met with in every ocean

Handbooks on the gyroscopic compasses have been issued by the firms making the various types, but these do not deal fully with the mathematical theory involved Dr Rawlings has therefore attempted to place this theory in the reach of any-one with an elementary knowledge of the differen tial calculus His book is written primarily for those engaged in the construction of compasses and for navigators, to whom it should prove most useful The opening chapters are devoted solely to the explanation of the action of the compass, the restraints imposed upon the gyroscope so that it shall be of use, and the problems involved in its oscillation, its damping, and its stability After this there are descriptions of the Anschutz, Brown, and Sperry-Rawlings Harrison compasses, while the later chapters deal with compensating weights, rolling error, damping error, and gimballing error, and the accuracy of the gyro compass at sea

The Court of Burgundy Studies in the History of Civilisation By Otto Cartellieri Translated by Malcolm Letts (The History of Civilisation Series) Pp xv + 282 + 25 plates (London Kegan Paul and Co , Ltd , New York Alfred A Knopf, 1929) 21*s* net

THIS volume in the History of Civilisation Series is one of peculiar interest for English readers The Burgundian court was a great formative influence in the history of European culture The four dukes who united Burgundy and Flanders under their rule in the period extending from the middle of the fourteenth century to the end of the fifteenth, gathered around them sculptors, painters, scholars, and poets from all parts of Europe, while their court was the last school of the dying order of chivalry The rivalry of the houses of Burgundy and Armagnac gave England the opportunity of intervention But the alliance between the English kings and the Burgundian dukes, which was a dominating factor in the troubled politics of France, had an abiding effect on English culture By ensuring an outlet for our wool trade in the great commercial centres of Flanders, it confirmed the development of English rural life and industry along the lines which ended in the formation of the great pastoral estates, with subsequent economic and social consequences known to all Prof Cartellieri here deals with a subject which he has made peculiarly his own His book is no mere recital of political events, but in a very real sense a social history in which every aspect of life, art, and literature is followed in detail One chapter deals with the famous witchcraft persecution at Arras

Exact Colour Matching and Specifying By L Blin Desbleds Pp 116 (Paris Technological and Industrial Service, n d) 25 francs , 4*s*

IN this work the industrial method of accurate colour measurement, and consequently of matching colours, made possible by the use of Toussaint's photo electric photo colorimeter, is set forth, with many practical examples, in a clear way It will generally be dyers and those dealing with fabrics who will find it useful

The uncertainty that must always be associated with eye observations, because of the variations of colour sensitiveness even in the same eye, is eliminated by the use of a photo electric cell through which an electric current is passed and upon which impinges the light reflected by or transmitted through the substance the colour of which is to be measured The readings therefore are of the position of a spot of light on a scale, as customary in the use of a reflecting galvanometer The light that impinges on the sample passes through one or other of (generally) six Wratten Kodak monochromatic filters transmitting known wave lengths Violet, blue, green, yellow, orange, and red are appropriate colours, and the results are plotted on a prepared form of wave lengths as compared with the same light as reflected from a white surface of plaster of Paris, or better, as more uniform, barium sulphate, which is taken as 100 From these curves all the information required for practical purposes can be found by simple calcula tions, and these are fully illustrated The volume is a manual for use in the works' laboratory

In the Land of the Lion By Cherry Kearton Pp 256 + 60 plates (London J W Arrowsmith, Ltd , 1929) 10*s* 6*d* net

MR KEARTON is probably our oldest and best known African picture shikari Having given us ' Photographing Wild Life Across the World", in which he recounts many ' hairbreadth escapes ' and exciting incidents with denizens of the wild, the actions of which he tried to portray, he now presents us with a book to gladen the heart of the Nature lover, dedicated by the by to his wife, her-self an author of repute In its twenty short chapters the author has something to say about most of the animals of the African bush and many birds and insects The best, perhaps, is his chapter on the white ant Systematic natural history is not his strong point, but his light sketches of the doings, family life, and frolics of the larger animals, lion, elephant, giraffe, hippopotamus, rhinocerus, and many more, are excellent reading, and conjure up fascinating pictures of wild life in sun scorched bush, river, and swamp

The eighty eight illustrations are mostly photo-graphs from the author's film " Tembi ", in our opinion one of the best Central African films yet produced The magnificent photograph of equa-torial glaciers and snowfields up in the clouds and far away is alone worth the cost of the book, which is tastefully got up and supplied with an efficient index

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Grating Errors and Electronic Charge

AN investigation of the focal properties of small plane gratings has led to a discussion concerning the influence of grating errors on X-ray spectra obtained by means of plane gratings. It may be of some interest to give here a brief account of the results, as they are of some importance with respect to the accuracy of the value of the electronic charge deduced from X-ray measurements.

As is well known, a linear change of spacing along the grating gives rise to focal properties. Thus, the incident beam being parallel, the diffracted beam will be convergent or divergent according to the direction in which the spacing varies and the location of the spectral line with respect to the central image.

If, now, in the portion of the grating effective in the formation of the spectrum the spacing varies linearly only in *one* direction, this will be of no influence on the wave-length measurements, as the diffraction pattern (in the Fraunhofer case) is symmetrical and the principal maximum is in its proper position, that is, in the same position as the principal maximum of a perfect grating with a spacing equal to the mean spacing of the defective grating (see, for example, Sparrow, *Astrophys. Jour.*, **49**, p. 65, 1919).

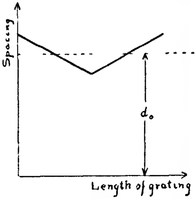

FIG. 1.

When, however, the effective portion of the grating contains certain regions where the spacing increases and other regions where it decreases along the grating, this may cause asymmetry and misplacing of the spectral lines.

A simple mode of demonstrating this is the following. We may, for example, assume that the spacing of the grating varies as in Fig. 1. Thus there is one portion of the grating where the spacing decreases linearly, and another, adjacent and equal in width, where it increases at the same rate along the grating. The diffracted beam from one portion will therefore converge to a real focus, and that coming from the other portion will diverge from a virtual focus behind the grating (see Fig. 2). Thus the maximum intensity will be shifted in relation to the central beam of the bundle. A more detailed communication, where this point of view will be more closely discussed, will be published in *Zeitschrift für Physik* shortly. In each case the only method which is without doubt entirely free from objections is the *exact* calculation of the diffraction pattern, but this is a work of some difficulty for the less simple geometrical conditions of the X-ray spectrographs.

Now all gratings ruled with the aid of a screw are affected with periodical errors, where the period of the error is equal to the pitch of the screw. When the number of periods in the effective portion of the grating is large, we know from theory and experiment that ghosts will occur in the spectrum ('Rowland ghosts'). When, however, the number of periods is *small*—this

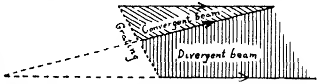

FIG. 2.

being the essential point in this account of the conditions—we may anticipate asymmetries of the kind above described.

As the pitch of the screws used in the common ruling machines is about 1.2 mm. and the length of the effective portion of the grating is about 2.3 mm. in the case of the experimental arrangements of the X-ray measurements considered, it is clear that the number of periods is small and that the risk of asymmetry of the spectral lines really exists. (As a matter of fact it is *necessary* to work with small portions of the grating in order to avoid the correction originating from lack of parallelism of the beams. See Porter, *Phil. Mag.* (7), **5**, p. 1067, 1928.)

In order to get some quantitative account I have calculated the diffraction pattern (in the *Fraunhofer case*) for the case shown in Fig. 1. The result is given in Fig. 3. The total number of lines in the grating is about 160. The *maximum* misplacing of a line (the misplacing at the ends and in the middle of the grating) in reference to the lines in a *perfect* grating of grating constant d_0 is 0.12 d_0, where d_0 is the mean spacing of the defective grating. Fig. 3 gives the amplitude as a function of wave-length. The vertical line denotes the position of the principal maximum for a perfect grating of grating constant d_0. Thus the principal maximum of the defective grating is shifted (in this special case about 0.0015 λ), and the distribution of intensity in the total diffraction pattern is asymmetrical.

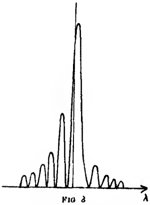

FIG. 3.

A general calculation of the shift of the principal maximum (in the conditions illustrated in Fig. 1) gives the following result:

$$\text{Error of wave-length } (a) = \frac{2\, m_{\max}}{l} \lambda$$

where m_{max} is the *maximum* misplacing of a line in the grating and l is the length of the grating

For $l = 1$ mm we get

if $m_{max} = 0\ 0005$	mm	$a = 0\ 001\ \lambda$
,, $= 0\ 00025$	,,	$a = 0\ 0005\ \lambda$
,, $= 0\ 0001$	,,	$a = 0\ 0002\ \lambda$

The X ray measurements considered are, as said above, of considerable interest on account of their importance as regards the value of the electronic charge (e) Now a certain error in the wave length gives rise to an error in e three times as large From the above discussion it appears that the error in e originating from the grating errors is very likely to amount to values comparable to the total error in e stated by some authors The object of this paper is thus to direct attention especially to the fact that the quality of the grating is of decisive importance to the accuracy of the value of e deduced from X ray measurements

SVEN FAGERBERG
Physics Laboratory, University,
Upsala, Nov 15

New Types of Emission Spectra

THE emission spectra which we observe in the visible and ultra violet region are divided into line and band spectra, of which the first type corresponds to electronic changes of state of single atoms either in neutral or in an ionised state The band spectra originate from molecules, and the energy quanta emitted in a certain spectral line draw their energy from three sources (1) change of electronic orbits, (2) change of vibrational energy, and (3) change of rotational energy

The study of the luminescence from solidified gases at very low temperatures has revealed a new type of spectra, which is a combination of electronic jumps and atomic oscillations, and we obtain a type of vibrational band spectra free from the influence of rotational energy Since their discovery in 1924 (*Comm Lab Leiden*, No 175) a considerable number of spectra of this new type has been studied, and numerous lines have been classified into vibrational series and systems of such series (See, for example, *Ann d Phys*, **79**, 1926, and *Comm Lab Leiden*, No 183, 200, and Suppl No 59)

Now it appears that most of the series are not composed of single lines, but of two or more components This splitting up of the lines is more pronounced at the temperature of liquid helium than at that of liquid hydrogen and for such series which appear strong in the afterglow spectra, and are undoubtedly emitted from matter in the solid state The multiplicity of lines is therefore not due to rotational energy

It might, then, at first sight seem reasonable to ascribe the splitting up of the lines to a multiplicity of the electronic terms Following up this idea, however, we meet with the difficulty that series with quite different electronic terms and different principal vibrational frequencies show very nearly the same frequency difference between successive components Thus the series called C, D, and E show a separation of about 45 cm $^{-1}$, and about the same difference is found for the doublets of the ϵ system In the case of the principal series of the ϵ system (the η series), we find, under certain conditions, that the 'lines' are split up into 4 7 components, with an approximately constant difference between successive components of about 40 cm $^{-1}$ The a series gives a separation of 69 cm $^{-1}$ A multiplicity of this type cannot be accounted for by the theory of electronic terms

Now the a-form of solid nitrogen was shown (*Zeits f. Phys.*, **58**, 497; 1929 NATURE, Aug 17, 31, 1929) to have a pronounced molecular structure, and the atomic distance and dissociation energy of the molecular elements of the lattice were found to be approximately identical with those of the gaseous molecules The ordinary oscillatory series correspond to atomic oscillations of the atoms of molecular elements in various states of electronic excitation The strong binding between the two atoms of a molecule corresponds to the high principal vibrational frequencies of the order of magnitude 1200 2400 cm $^{-1}$ But a molecule with vibrating atoms may itself be vibrating on account of the forces which bind the molecules in the crystal lattice, and which are closely related to the elastic forces of the crystal

As the distance between the molecules is much greater than that between the atoms of a molecular

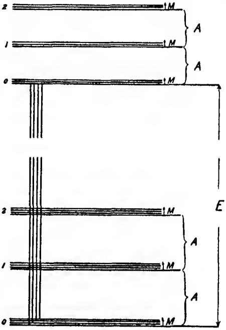

FIG 1
E—Change of energy of electronic states
A—Change of energy of atomic vibrations
M—Change of energy of molecular vibrations

element, it is to be expected that the internal state (either electronic or vibrational) of the molecule will have little influence on the molecular vibrations, and thus we may understand that the separation of lines on account of molecular vibrations may be approximately the same for series corresponding to different internal states of the molecular elements

Thus we are dealing with a type of spectrum where the frequencies are modified from the following three causes (1) Change of electronic states (2) Change of vibrational energy of the atoms of a molecular element (3) Change of vibrational energy of the molecular elements in the crystal lattice

The formation of a spectrum of this type is shown in Fig 1

L VEGARD
Physical Institute,
University, Oslo, Nov 28

Recovery from Parasitism

THE pine shoot moth, *Evetria buoliana*, Schiff, one of the best known Lepidopterous pests of young Scots pine in Europe, has during the past decade been causing much concern by its increasing prevalence in the numerous young pine plantations in East Anglia Just over a year ago a thorough study was begun of

the biology and forest relations of the species, the first results of which have been worked out Amongst other things it has been found that a slight check is exercised on the increase of the insect by a number of different species of parasites which oviposit in the newly hatched caterpillars and the flight periods of which correspond roughly to that of the moths, and in this connexion an interesting fact has already been brought to light

Caterpillars collected from different areas were bred out either to the adult moths or to parasites, and it was found that those which came from areas in which the percentage internal parasitism of the caterpillars was high, yielded some fertile moths which were much smaller than the 19 mm wing span given by Meyrick[1] as the minimum for the species From others which came from areas in which the percentage parasitism was low, such small moths were extremely rare For example, from 300 caterpillars parasitised to the extent of 80 per cent, 7 per cent of the emerging moths had a wing span ranging from 13 mm to 17 mm, while caterpillars parasitised to the extent of 70 per cent only gave about 2 per cent moths of the small type, and from caterpillars with a percentage parasitism of less than 60 per cent, only two small moths were bred out as against more than 400 of the normal type

In considering the significance of these results, it has occurred to me that the prevalence of these small moths may be connected in some way with the high percentage of internal parasitism and that they may possibly be the results of a recovery from parasitism

Recovery from parasitism by phagocytosis of the parasites' eggs or newly hatched larvæ has been described in detail by Timberlake,[2] and such recovery has been noticed occasionally in the young caterpillars of *E buoliana* but appears to have no effect on the ultimate size of the adult moth In the present case the results so far obtained tend to show that recovery probably takes place at a later stage in the life history

Tothill[3] has pointed out that the active histolysis which takes place in the pupal and prepupal stages of a moth renders them unsuitable feeding grounds for those internal parasites which are devoid of some means of protection such as a trophamnion It is easy then to imagine that if for any reason the development of a normal internal parasite was delayed until the host reached the prepupal stage, the parasite larva would be attacked by the active phagocytes, broken down, and its substance probably built up into the tissues of the adult moth

Such retardation of the parasite larvæ was often noted when super or multiple parasitism occurred Caterpillars containing two or more living first stage parasite larvæ which would have taken well over a month to develop, were found less than three weeks prior to the date of the last recorded emergence of the parasites That these parasites would have emerged is highly improbable, and one must suppose, therefore, that in such cases there would be either a recovery from parasitism, or that total death by mutual exhaustion of the complex would have taken place

The caterpillars are, however, only slightly retarded in their development by the presence of internal parasites, but after the first instar are invariably found to be smaller both in general bulk and in the measurements of the head capsule than unparasitised specimens of the same stage This makes it impossible to apply Dyer's law for the separation of the stages, to any but unparasitised individuals From the above evidence it seems probable that a recovery from parasitism has taken place in the prepupal or pupal stage of the moth

The type of small pupæ from which these moths emerged also showed a greater percentage mortality than the normal type, and if the hypothesis advanced is correct, it is natural that after a severe drain of blood plasma from the feeding of the parasite larvæ their vitality should be lowered

No direct evidence of this recovery has been noted in the small amount of preserved material yet examined, but this need not be taken as negative evidence The actual process may be very rapid, and as it only occurs in a small percentage of the caterpillars at a stage not yet definitely known, many hundreds of futile dissections may have to be made before one can expect results

If it can be definitely established that recovery from parasitism can take place as suggested at a later stage in the host's life cycle, it may throw light on many details of parasitic (internal) control of pests in general and account for their usual incompleteness in exterminating a host It is generally considered that 100 per cent parasitism brings about total extinction, but such a percentage would involve a large proportion of supernumerary parasites which, causing mutual retardation, would allow a large percentage recovery of the host In all probability the maximum mortality will occur when the host has a percentage parasitism of less than 100, but this maximum will never be 100 per cent in hosts in which such recovery occurs C CRAWSHAW BROOKS

Imperial Forestry Institute,
University of Oxford,
Dec 6

[1] E Meyrick 'Revised Handbook of British Lepidoptera', 1927

[2] P H Timberlake 'Experimental Parasitism', U S Department of Agriculture. Bur Ent. Tech Ser, No 19, Pt 5, 1912

[3] J D Tothill 'Natural Control of the Fall Webworm' Dom. Can Dept. of Agric, Ottawa, Bull 3, 1922

Occurrence of *Craspedacusta* (*Limnocodium*) *Sowerbii* in the Exeter Ship Canal

DURING the summer of 1928, while collecting Crustacea and other forms of fresh water life in the Exeter ship canal, I had the good fortune on July 21 to find in a hand net gathering, made midway between the Turf Hotel and Topsham ferry boat landing, two small medusæ quite new to me These I preserved, and later sent them to Mr Edward T Browne, who identified them as *Craspedacusta Sowerbii* A short time later, Mr Browne kindly sent me a tow net, but the great difficulty then was to get a boat However, I succeeded in obtaining more than a hundred specimens, ranging from early stages up to the fully grown adult The medusa was present in the canal up to Sept 8, when some early stages were taken During the past summer (1929) I have been more successful, and have been able to get a suitable punt whenever I wanted one

My studies in this interesting medusa have not been so complete as I could have wished, but I have published these notes in the hopes that others younger than I will be attracted to study the fresh water life in this interesting canal

According to Mr P C De la Garde—"On the Antiquity and Invention of the Lock Canal of Exeter" in a letter from Philip Chidwell de la Garde, to Sir Henry Ellis, F R S, Secy Read Jan 11, 1838 From *Archæologia*, 5, 28—the Exeter ship canal was completed about the year 1698 so far as Topsham "In the year 1829", writes Mr de la Garde, " it was extended to Turf It is now upwards of five miles and a half in length It has two entrance locks, one at Turf and another opposite Topsham Between these and Exeter it has only one lock, the old double

lock altered and improved. The Canal is 34 feet wide at the bottom, and 94 feet at the surface of the water, with 15 feet of water throughout."

This fresh-water canal, which receives its water from the River Exe, teems at certain seasons of the year with an abundance of microscopic life. Besides fish of various species, *Paludina vivipara* and *Dreissena polymorpha*, two most interesting molluscs, are always present; while *Cristatella mucedo* can be found in the higher parts of the canal; *Plumatella repens* and *Cordylophora lacustris*, near the Topsham lock gate.

It is interesting to record that, up to the present, I have been unable to make one addition to the lists of fresh-water Crustacea recorded by Canon Norman and Thomas Scott in "The Crustacea of Devon and Cornwall."

Owing to ill health, I was unable to commence my fresh water collecting until July 8 last, when no medusæ were to be found. My next collecting trip was made two weeks later, when I found the medusæ plentiful. Surface temperature 65° F. From that date until Oct. 14, medusæ were present in varying numbers. On Sept. 5 the surface temperature was 72° F. and the canal was found swarming with medusæ; they were so abundant that one could see them with the naked eye. From that day until the fall of the year, the medusæ gradually decreased in numbers. On Oct. 1 not more than twenty medusæ were caught, surface temperature being 60° F.; and on Oct. 14 they vanished for the year, surface temperature being 57° F. Although I have collected at various points along the whole canal, I have not found any medusæ above the double lock.

According to my observations there appear to have been at least four distinct broods of medusæ in the canal during the past summer on or about the following dates: July 20, Aug. 24, Sept. 5 and 19.

All the specimens taken were males, and a special search was made for its hydroid, known as *Microhydra*, without success, but it must be somewhere in the canal.

Both the hydroid and its medusa have been found in streams and ponds in the United States, but this is, so far as I know, the first time the medusa has been taken under natural conditions in Europe, where it has been found under artificial conditions; usually in warm water tanks belonging to botanical gardens.

RUPERT VALLENTIN.

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Magnetic Moments of Atomic Nuclei

THE hyperfine structures of atomic spectra are considered as due to the interaction of the nuclear spin with the electronic orbital and spin moments. A theoretical calculation of this interaction enables one to obtain information on the magnitude of the magnetic moments of the nuclei from the separation of the hyperfine structures. This can be done for the case of the alkali atoms. Hargreaves (*Proc. Roy. Soc.*, **124**, 568; 1929) has calculated the separation due to a nuclear moment $h/4\pi$ for the case of atoms with only one electron. In his calculations, however, the interaction between the electronic and nuclear spins, which is of the same order of magnitude as the other terms, has been neglected. I have therefore carried out the calculations with the following improvements. For the s terms, which is the most important case, since they give the largest contribution to the separation, I have used Dirac's theory of the electron, since the simpler Pauli's theory gives a wrong result. For the p-terms I have used Pauli's method, taking into account the interaction of the nuclear and electronic spins. For the p-terms it is not necessary to evaluate numerically the eigenfunctions, since the constants involved in the formulæ can be derived from empirical data on the separation of the electronic spin doublets. For the s terms this is of course impossible, and I have calculated the eigenfunctions by the statistical method.

If the mechanical and the magnetic moments of the nucleus are respectively $kh/2\pi$ and μ_0, one finds that the s terms split into two components with a separation

$$(1) \qquad \Delta = \frac{2k+1}{k} \cdot \frac{8\pi}{3} \mu\mu_0 \psi^2(0),$$

where μ is Bohr's magneton and $\psi(0)$ is the value of the normalised eigenfunction at the origin. The separation of the p terms is much smaller. Each line of the principal series of the alkalis splits, therefore, into two components with the separation Δ, each of them having a finer structure, which is not resolved, and gives rise to small differences in the observed separation for the different lines. The ratio of the intensities of the two components is $(k+1)/k$, the weaker component being shifted towards the violet. The ratio of the intensities is also 3, 2, 5/3 ... 1 for $k = 1/2, 1, 3/2$ ... ∞.

For cæsium one finds, in wave numbers,

$$\Delta = 146 \frac{\mu_0}{\mu} \frac{2k+1}{k},$$

and for sodium

$$\Delta = 13.4 \frac{\mu_0}{\mu} \frac{2k+1}{k}.$$

The observed values are, for cæsium (D. A. Jackson, *Proc. Roy. Soc.*, **121**, 432; 1928) $\Delta = 0.3$, and for sodium (H. Schuler, *Naturwiss.*, **16**, 512; 1928) $\Delta = 0.06$ wave numbers. From this, on the assumption of the values 1/2, 1, 3/2, ..., ∞ for k, we obtain the following values for the ratio μ/μ_0 of the Bohr magneton to the magnetic moment of the nucleus:

$k =$	1/2	1	3/2	∞
Cæsium	1950	1460	1300	980
Sodium	890	670	600	450

From the observed ratio of the intensities in sodium one should expect a probable value for k of 1 or 1/2.

The uncertainty of the given values arises from the lack of precision of the empirical data and from the application of the statistical method to the evaluation of the eigenfunctions. This latter source of error might be evaluated to within 20 or 30 per cent.

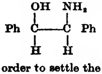
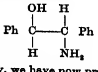
Further details will be published later.

E. FERMI.

Physical Institute of the University,
Rome, Dec. 4.

Optically Active Diphenylethylene Oxide

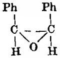
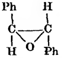
WE have recently been able to obtain optically pure *d*- and *l* *iso*hydrobenzoin, Ph.CH(OH).CH(OH).Ph, by the action of nitrous acid on *d*- and *l*-*iso*diphenylhydroxyethylamine (*Jour. Chem. Soc.*, 1929, 2305). This result might be considered to point to configuration (ii), rather than (i), for *iso*diphenylhydroxyethylamine, except for the circumstance that *l*-*iso*hydrobenzoin is furnished in this way by *d*-diphenylhydroxyethylamine as well as by the *l*-*iso*base.

(i)  (ii) 

In order to settle the ambiguity, we have now prepared specimens of 2 : 3 diphenylethylene oxide from each of these bases, through the quaternary ammonium hydroxides, Ph.CH(OH).CH(NMe$_3$OH).Ph. The

optically active and externally compensated forms of the *iso*base yielded an identical optically inactive diphenylethylene oxide, which therefore corresponds to the *cis* configuration (iii), with a plane of symmetry (indicated by the broken line) *d* Diphenylhydroxyethylamine, however, gave a strongly lævo rotatory oxide, to which the *trans* configuration (iv) must be assigned It follows that the relative molecular configurations allocated to the above bases by Erlenmeyer in 1899 must be reversed, the base and the *iso*base being represented by (ii) and (i), respectively We propose to explore further this valuable general method for determining the relative molecular configurations of such substances

The stereoisomeric diphenylethylene oxides present several features of unusual interest

(iii)  (iv) 

The *trans* form (iv) is an example of the simplest type of cyclic structure which can give rise to dissymmetry of molecular configuration it will be noticed that the assemblage of five single atoms carrying two identical radicals still displays axial symmetry, although a plane of symmetry is no longer present These simple structural constituents may be compared instructively with the four single atoms and one group of the simplest known acyclic dissymmetric compound, chloroiodomethanesulphonic acid, that is, CHClI SO_3H The specific rotatory power of the *l* form of the above oxide (iv), observed in absolute alcohol for sodium light, exceeds $-300°$, while the corresponding value for *l iso*hydrobenzoin (its configurational analogue) is only $-92°$ thus, the optical effect of the 3 membered ring is strikingly apparent The extraordinary stability of these well defined crystalline oxides is in keeping with the views of Thorpe and Ingold on the effect of substituents in relieving the strain inherent in small rings

Other compounds of the same general type which we are at present investigating exhibit an equally pronounced stability, among them, the *cis* form of 2 3 dianisylethylene oxide has been obtained by the direct interaction of nitrous acid and the corresponding dianisylhydroxyethylamine, as well as from the same base by the general method indicated above Details of these studies and of further work directed towards the preparation of optically active ethylene oxides, containing aromatic or aliphatic substituents, will be published elsewhere

JOHN READ
ISHBEL G M CAMPBELL

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Do Oceanic Plankton Animals Lose Themselves?

RECENT researches into the behaviour of plankton animals in the sea as to their vertical movements from day to day indicate that light intensity is an important factor The animals appear in Nature to be brought around an optimum intensity by some tropistic mechanism and, assuming this, there seems likely to be a lower limiting or threshold intensity below which no stimulation takes place Such, indeed, appears to be the case at night with animals living in our shallower offshore waters, when, with the release of the light stimulus in darkness, they are free to roam anywhere and become evenly distributed throughout the water layers, within the limits of other controlling factors such as temperature and salinity This lower threshold intensity idea receives support from a paper published in 1926 by two Japanese workers, M Tauti and H Hayasi (*Jour Imper Fisher Instit*, Tokyo, vol 21, No 4, p 42), who found that if a light be projected at night vertically downwards into the water, fish swimming in numbers deeper in the water are only attracted individually to the light when by random movements they swim upwards into a certain threshold intensity

In view of these observations, the suggestion arises whether certain plankton animals which normally live in light of moderate intensities near the surface, but are to be found also in the deep, dark layers of the open ocean, are not, so to speak, lost in these latter layers Have they moved out of their normal light zone, perhaps at night, and reached layers at which the intensity is below the threshold, thus to be doomed to everlasting night until perchance by random movements one bright day they swim once more into the threshold intensity zone and are attracted upwards to their optimum intensity ?

F S RUSSELL

Marine Biological Association,
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Magic Square of Fifth Order

I VENTURE to send you what I believe to be a very rare magic square of fifth order Although there are more than 260,000 bordered squares of fifth order with the number 13 in the centre of the square, it seems a very rare thing indeed for any other number than 13 to be in the centre I have not found any with the

23	20	10	4	8	
22	2	16	18	7	36/29
14	13	17	6	15	Magic
5	21	3	12	24	number 65
1	9	19	25	11	

usual proportion (39/26) between the Row of the Heart and the rest of the Row, and it was not until the proportion 36/29 arrived that I found it was possible to make one I append the square Subtracting each number from 26 will give the proportion 42/23 I believe there are only two (not including inversions) with 17 in the centre of the square

J C BURNETT

Barkston, near Grantham, Dec 2

Legitimate Uncertainty

ADVANCE of inquiry into fundamental tracts of Nature is often perforce conducted by means of symbolism The comprehensive character of the symbols counts for increase of knowledge, even though their physical interpretation is still shrouded in uncertainty Thus it is that, for example, Prof Eddington, on page 291 of "The Nature of the Physical World", amusingly sums up our present knowledge of electronic operations inside atoms by saying "*Something unknown is doing we don't know what*—that is what our theory amounts to" Similarly the sentences quoted from one of my books, at the end of a review on page 942 of NATURE for Dec 21, should be understood, not as a hopeless and helpless admission of ignorance but as a scrupulously fair and cautious stage in the advance of knowledge, for it is no gain to science to attempt the formulation of a nascent theory prematurely

OLIVER LODGE

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Cycles in Natural Phenomena.

IN December 1922, Dr Merriam, president of the Carnegie Institution of Washington, called a conference to discuss the question of 'cycles' The report of this, and of a second conference held in December 1928, have now been published by the Carnegie Institution,[1] and the two reports form a stimulating contribution to the subject The members took a very broad view, which was set out by F E Clements in an introductory paper as follows "It seems desirable to use cycle as the inclusive term for all recurrences that lend themselves to measurement, and period or periodicity for those with a definite time interval, recognising, however, that there is no fixed line between the two On this basis there can be no question of the existence of climatic and other cycles, though there may be the gravest doubt of the reality of periodicities in climate beyond that of the year "

The greatest emphasis naturally falls on cycles of climate, which underlie most known cycles of other terrestrial phenomena, such as crops and prices, growth of plants, and fluctuations in numbers of animals, while climatic cycles are themselves most probably reflections of cycles of solar activity Unfortunately, however, the systematic observation of climate is of comparatively recent growth, and very few homogeneous series of meteorological records exceed one hundred years This is sufficient for the accurate study of weather periodicities of a few years in length, but is quite inadequate for the determination of longer cycles, from twenty or thirty years upwards The meteorological records, for example, have hitherto proved insufficient to determine the real nature and extent of the well known Bruckner cycle of about 35 years

On the other hand, there exist several natural agencies which have the power to integrate the meteorological conditions during a period of a few months or a year, and register the results in some permanent form The two most notable of these agencies are trees, which by the width of their annual rings show their rate of growth during each of a long succession of years, and melting glaciers, which leave behind them records of the volume of thaw water

The investigation of the annual rings of trees has found its home in the United States, where it is associated especially with the name of A E Douglass, who in 1922 was able to present conclusions based on the dating and measurement of more than 110,000 rings in nearly 500 trees, all carefully collated and compared It has been generally accepted that in the dry climate of Arizona and California the redwood, *Sequoia*, grows most rapidly in relatively rainy seasons, but the nature of the relationship between tree growth and weather is examined more closely in a paper read at the 1928 conference by O T MacDougal Since 1918, MacDougal has been obtaining measurements by means of the 'dendrograph', an instrument which makes a continuous record of the diameter of a tree between two contact points on opposite sides of the trunk

The trees chiefly examined were the Monterey pine and the coast redwood From the records illustrated, it seems that the pine grows most rapidly in late spring, the tree forms no reserve of starch, and in a dry situation the growth is closely related to the rainfall of the preceding winter If abundant soil moisture is available, however, growth is greatest in dry years with few fogs, abundant sunshine, and high temperature The meaning of the record made by the pine, therefore, depends on its situation On the other hand, the redwood accumulates a reserve of starch, and moreover, it grows only in situations where the soil moisture does not fall below a certain percentage Hence the correlation between the width of the annual rings and the rainfall in individual years is smaller than with the pine, but the redwood gives an excellent measure of the long period fluctuations of rainfall It also seems probable that temperature plays a more important part in the growth of the redwood than that of the pine

On the whole, the pine is probably the better index of rainfall, but it is relatively short lived Four of the Sequoias measured began their existence more than 3000 years ago, but few pines go back more than 500 years, the oldest covering a period of 640 years This difficulty has been partly overcome by the use of historic and prehistoric material, and the available pine records now cover two nearly equal periods, totalling about 1255 years, but unfortunately separated by a gap of unknown duration When this gap has been filled, the whole series will become a continuous climatic record of the highest value

The harmonic analysis of a very long series of data is a laborious occupation, and for the purpose of studying the variations of his tree measurements, in 1913 Douglass invented an ingenious optical instrument for determining the lengths of periodicities A large instrument with photographic attachment was constructed with a fund given by Mr Clarence G White, and the instrument has been termed the 'White Cyclograph' The earlier form suffered from the disadvantage of a rather limited range, the longest periodicity which could be determined being only seven times the shortest, but in an improved form described at the 1928 conference a device is incorporated which more than doubles this ratio The principal result obtained up to the present is that most of the cycles of growth shown by the western tree-rings are probably simple fractions of a Brückner cycle of 34 years

Another series of data which may prove of value is that relating to waves of infectious diseases, discussed by Dr W C White These may be related to cycles of solar radiation of various wavelengths, but very little is yet known as to the nature of the relationships, and the conclusion

[1] "Reports of the Conferences on Cycles" Pp 88 (Washington, D C Carnegie Institution, 1929) Free on request.

reached is that there is a greater likelihood that a knowledge of weather cycles will help the study of preventive measures against disease than that a knowledge of the history of epidemics will further the study of weather cycles

The view has often been expressed that by far the greater number of weather cycles will prove to be intimately related to cycles of solar variation Unfortunately, only one of the latter can be regarded as fairly established, namely, the double sunspot period of 22½ years The shorter cycles which are believed to exist in solar radiation are not well shown by the sunspot numbers, and reliable measurements of solar radiation do not yet cover a sufficiently long period to give conclusive results At the second conference, C G Abbot presented the results of the harmonic analysis of 100 months of data ending in October 1928, but probably the only periodicity so found which has any claims to reality is that of 25 months (an inspection of the author's diagram suggests that the real periodicity is slightly longer, perhaps 26 months) It seems that we shall have to wait many years for a full study of the periodic variations of solar radiation based on a sufficiently long series of observations

The greatest mass of material awaiting systematic periodogram research is to be found in the deposits left by the waters issuing year after year from the ends of the glaciers These waters deposit a fine clay, but the winter deposit, when the glacial streams are at a minimum, differs in colour and texture from that of the streams swollen by the summer thaw Hence the layer added each year can be readily detected and its thickness measured, giving what is essentially a representation of the average summer temperature These glacial deposits have been carefully studied by de Geer, Antevs, and others in Scandinavia, Finland, North America, the Argentine, and the Himalayas, and in Scandinavia it has proved possible to connect up the deposits with those forming at the present day and so obtain an accurately dated series of measurements covering a period of more than 20,000 years

Hitherto, statisticians have quailed before the immense task of analysing this record for periodicities, and in his paper Antevs quotes only two determinations, both rather casual In the Argentine series periodicities of 5 1, 10 4, and 51 years were found, while in the North American series there is a strongly marked periodicity of two years, besides others of three to eight years Neither investigation discovered the eleven year sunspot cycle, a remarkable result which is at variance with the claim of de Geer, embodied in his title ' the solar curve ", that the series of clay thicknesses is a measure of the variations of solar radiation from year to year

This does not exhaust the possibilities of wresting from Nature detailed evidence of her past vicissitudes Peat bogs in many countries enshrine the history of post glacial vegetation, and though by its nature this record cannot be made to give numerical annual values comparable with those from the trees or the glacial clays, it should—when it is fully understood—provide valuable information as to the longer sweeps of climate, which will form a base line for the variations of shorter period revealed by the more detailed sources

From the reports as a whole, it appears that on all sides forces are being marshalled for a combined attack on the weather changes in post glacial times, which cannot but throw much light on the changes in process at present As Dr White phrased the problem in the discussion, ' Surely it should be possible by careful planning and co-ordinated study to construct relatively complete records from the present year backward into Pleistocene time, though that is but a beginning of the baffling if not insuperable task of constructing a continuous record that will reach back into the Tertiary " C E P B

Recent Work on Yellow Fever

THE opening address of the Cambridge Philosophical Society on Nov 11 last was delivered by Prof E Hindle, the Beit research fellow in tropical medicine, who gave an account of recent work on yellow fever The paper for the most part was a description of experiments on yellow fever which have resulted in his discovery of a method of vaccination against this disease

West Africa is now the main endemic centre of yellow fever, although serious epidemics have occurred in Brazil during the year 1929 A new era in the study of the disease was opened by the discovery in 1927 by Stokes, Bauer, and Hudson, that Asiatic monkeys, and especially *Macacus rhesus*, can easily be infected with yellow fever Afterwards, Dr Adrian Stokes working at Lagos, and also Drs Young and Noguchi at Accra, died of yellow fever acquired in the course of their investigations Prof Hindle described how he succeeded in getting the virus of the disease brought back to London Pieces of the liver of an infected monkey in Senegal, killed at the height of the disease, were kept frozen during the voyage to London, a period of 12 days, and with this material the disease was reproduced in England at the end of March 1928 Since that date, the strain has been maintained by Prof Hindle at the Wellcome Bureau of Scientific Research and has been distributed to laboratories in Paris, Berlin, and Amsterdam The method consists of keeping the virus frozen, in which form it will survive for three to four weeks, or preferably to dry infected blood or tissues *in vacuo*, and keep it in the presence of a desiccating agent, when the virus will survive for 3-4 months Monkeys can easily be infected by the inoculation of blood or liver from an infected animal, and 1/1000000 c c of infected blood has been found sufficient to produce infection

Transmission experiments with both Indian and West African races of *Aëdes ægypti* (*Stegomyia fasciata*) reared in England have shown that the disease can easily be transmitted from infected monkeys to normal animals by the bites of these insects, on condition that an interval of at least 9 days at 28° C is allowed to lapse after the infective feed During this incubation period the virus has been found to be constantly present, not only in the gut, but also in the cœlomic fluid, as determined by inoculation experiments into susceptible monkeys Once infected, a mosquito remains infective for the duration of its life, and, moreover, it was found that this infectivity persists even if the temperature is continually below 18° C Formerly, it was supposed that the distribution of the disease was restricted by the mosquito being unable to transmit the infection below a certain temperature, but Prof Hindle's experiments show that this view can no longer be maintained The results of experiments with the Indian race of *Aëdes* constitute the first proof that they are capable of transmitting yellow fever, and it is evident that if, by any ill chance, this disease ever reached the Orient, the local race of mosquitoes could serve as efficient carriers

It has been know from early times in the history of the disease that an attack is followed by a high degree of immunity, and the serum of convalescent patients, if inoculated into monkeys, will protect them against infection for a period of about one month The presence of active immune bodies in the blood of recovered patients furnishes a means of finding out whether a person has had the disease, for it is only necessary to inoculate a rhesus monkey with the serum of a suspected case and at the same time with yellow fever virus Employing these methods in West Africa, the Rockefeller Commission had detected the existence of yellow fever in villages where no obvious signs of the disease were present

Employing these methods, the nature of two atypical cases of yellow fever contracted in the laboratory in London was discovered In both patients (Prof Hindle and his laboratory attendant), the symptoms, a sharp fever of short duration, closely simulated, and at the time were attributed to, influenza After the fever, however, in both cases the blood contained immune bodies against yellow fever, as tested by inoculation into monkeys, and therefore there can be no doubt that they had both had an attack of this disease

It may be added that jaundice and albuminuria, although looked for, were not detected, and the only characteristic symptom was hyperæsthesia of various parts of the body in one patient which persisted for 3 to 4 weeks These results, combined with the production of immunity by the inoculation of sub lethal doses of virus, furnish additional evidence in support of the view that mild cases of yellow fever may occur which present none of the ordinary symptoms of the disease These cases would never be recognised in the ordinary course of events, but would be capable of infecting mosquitoes that fed on them and thus maintain the infection in a latent or hidden form

An interesting case of tissue immunity was described The liver and spleen of monkeys that have recovered from yellow fever, when inoculated into normal monkeys in 1 gm doses, immunised them against subsequent inoculations of fresh virus The brain, kidney, and lymphatic glands of convalescent monkeys did not possess this property The inoculation of hyperimmune serum into infected monkeys, after the commencement of fever, had no obvious effect on the course of the infection, and consequently there is doubt as to the value of serum treatment in human cases of yellow fever

Great hopes had been placed on Noguchi's vaccine prepared from *Leptospira icteroides*, erroneously supposed by him to be the causative organism of yellow fever It is now known that this organism is identical with that of spirochætal jaundice, therefore the vaccine prepared from it can have no value in yellow fever prophylaxis and its use has been abandoned

Prof Hindle decided to apply methods of vaccination which have proved successful in the production of vaccines against such diseases as fowl plague, dog distemper, etc In June 1928 (*Brit Med Jour*, June 9, 1928) he showed that a phenol-glycerine emulsion of the liver and spleen of infected monkeys confers a very high degree of protection against very large amounts (10,000 to 100,000 lethal doses) of the virus A formalinised suspension shows the same vaccinating property During the past eighteen months these experiments have been extended and full details were given of the method of preparing this vaccine The earlier phenol glycerine vaccine has been replaced by a formalinised one, as the infection of glycerine is painful

The present method of preparing the vaccine is as follows The liver is removed from an infected monkey killed in the last stage of the disease, when the temperature begins to fall The organ is weighed and ground up in a mortar with fine sand A measured quantity of 9 per cent salt solution, equal to half the original weight of the tissue, is added and the mixture allowed to stand for a few hours Then distilled water is added equal to nine times the volume of the strong salt solution As a result, all the cells are cytolised liberating the contained virus, and one obtains a 20 per cent suspension of tissue extract in normal saline This suspension is allowed to sediment, then filtered through muslin Part of it is tested for virus content, and a 1 in 10,000 dilution of the original tissue should produce a fatal infection in a monkey

The virus suspension is killed by the addition of 1 to 2 per 1000 formaldehyde, and after twenty-four hours can be used as a vaccine, if it passes the usual sterility tests

Both phenol-glycerine and formalinised vaccines, when kept in the ice chest, have been found to preserve their properties for some months The first has also been dried *in vacuo*, after removing

the glycerine by dialysis, and found to retain its properties

Monkeys inoculated with these vaccines show a high degree of protection against yellow fever, and this protection has been tested against the inoculation of fresh virus and the bites of infected mosquitoes up to 4½ months after vaccination, without showing any signs of diminution In the majority of cases, about ten days after being vaccinated the monkeys were inoculated with 0 1 gm infected liver material, equivalent to 1000 to 10,000 lethal doses, and in some instances with very much greater quantities of virus

These results have been confirmed by Pettit and his collaborators working in Paris, and Aragão in Rio de Janeiro, who used a Brazilian strain of yellow fever Aragão obtained constant protection in monkeys, and therefore tested the vaccine in human beings, using a 20 per cent suspension of liver, spleen, brain, and kidney containing 2 per 1000 formaldehyde and 0 5 per cent phenol This vaccine was administered subcutaneously in 2 c c doses to the laboratory workers at the Institute Oswaldo Cruz, with no ill effects, and afterwards used in a small epidemic of yellow fever Between three hundred and four hundred people were vaccinated, including the health officers working in the infected neighbourhoods, and people living either in the same house or the vicinity of yellow fever cases Although no unwarranted conclusions were drawn, none of the vaccinated contracted the disease, although some of them must have been exposed to infection

The use of this modification of Hindle's vaccine has now been adopted by the Public Health Department of Brazil, and during the epidemic in Rio de Janeiro early in 1929 approximately 30,000 persons were vaccinated against yellow fever

In West Africa, there is urgent need for some additional method of protection against yellow fever, as evidenced by the number of past epidemics, for at present there seems to be no likelihood of anti mosquito campaigns succeeding in eradicating all chance of infection Accordingly, the British Colonial Office, and also the French and Belgian Governments, have decided to test this vaccine in their West African colonies

Prof Hindle is of opinion that, by the general use of a vaccine of this nature of proved efficiency in monkeys, there is every hope of yellow fever ceasing to be a source of danger in the world

Scientific Centenaries in 1930

THOUGH the year 1930 will not see the commemoration of any scientific centenary of such widespread interest as that of Faraday's discovery of electromagnetic induction, which will be celebrated in 1931, the year will recall a number of eminent men who have made notable contributions to many departments of science

The most famous name which appears among the centenaries for 1930 is that of Kepler, who died on Nov 15, 1630, at the age of fifty eight years Kepler forms a link between the sixteenth and seventeenth centuries Among those born in 1630 were the German chemist, Kunckel (1630–1703), who assisted in emancipating the literature of chemistry from the mysticism of alchemy, and Isaac Barrow (1630–1677), Gresham professor of geometry, first Lucasian professor at Cambridge and master of Trinity College, teacher and predecessor of Newton and one of the greatest religious scholars of his time Another name, also associated with Cambridge, is that of Thomas Plume (1630–1704), vicar of Greenwich and archdeacon of Rochester, whose preaching appealed to Pepys and Evelyn, and who, through reading Huygens' "Cosmotheoros", recommended to him by Flamsteed, left funds for erecting an observatory at Cambridge and for maintaining a professor of astronomy and experimental philosophy The first to become a Plumian professor was Roger Cotes, while the first observatory founded through Plume's generosity was over the King's Gate of Trinity College

The work of the eighteenth century is recalled by the names of Bezout (1730–1783), a mathematician of distinction, of Bochart de Saron (1730–1794), one of the first astronomers to suggest that Herschel's newly discovered body was a planet, and one of the French men of science who perished beneath the guillotine, of Messier (1730–1817), Louis XV's 'comet ferret', regarded at one time as the leading practical astronomer in France, and by that of Bossut (1730–1814), friend of Condorcet, D'Alembert, Bailly, and Lavoisier, a pioneer in the study of hydrodynamics and one whose work contributed to the improvement in the sailing qualities of the ships of the French Navy

Other scientific workers also born in 1730 include the English amateur astronomer, Aubert (1730–1805), the intimate of Smeaton, Banks, and Herschel, Josiah Wedgwood (1730–1795), the Boulton of the pottery industry, Ingenhousz (1730–1799), the Dutch physicist who spent the latter part of his life in England, and Duhamel (1730–1816), to whom France is indebted for improvements in steel making

Of men of science who died a hundred years ago, Fourier (1768–1830) was the most famous His "Théorie analytique de la chaleur" appeared in 1822, and it was Comte who predicted that when Fourier's doctrine was better known much use of it would be made in other branches of physics If Fourier recalls the golden age of French mathematics, the name of Cremona (1830–1903) brings to mind one who, last century, reorganised mathematical instruction throughout Italy His birth took place on Dec 7, 1830, and to 1830 also belong the names of H A Newton (1830–1896), both mathematician and astronomer, Carl Bruhns (1830–1881), friend of Encke and Galle, and director of the Leipzig Observatory, and the three eminent chemists, Raoult (1830–1901), recipient of the Davy Medal in 1892, Bemmelen (1830–1911),

who contributed to the founding of the Dutch school of physical chemistry, and Lothar Meyer (1830–1895), best known for the share he had in the periodic classification of the elements, and whose memorial lecture before the Chemical Society was delivered by Prof Bedson in 1896

The year 1830 also witnessed the death of Major James Rennel (1742–1830), the eminent geographer, who is buried in Westminster Abbey, of Richard Chenevix (1774–1830), the Irish chemist and mineralogist, whose name, like that of Rennel, is in the list of Copley medallists, and of Henry Bell (1767–1830), the steadfast but unfortunate promoter of steam navigation, whose *Comet* was the forerunner of the *Mauretania*, and it also saw the birth of David Edward Hughes (1830–1900), inventor and physicist, founder of famous scientific prizes and benefactor of the London hospitals, of Sir Edward Reed (1830–1906), the most prominent naval architect of his time, and of Gerhard von Rath (1830–1888), the Bonn mineralogist It also was marked by the founding of the Royal Geographical Society, while in January 1830, Lyell, then thirty two years of age, published the first part of his "Principles of Geology", that classic which Geikie said "must form an early part of the reading of every man who would wish to make himself an accomplished geologist"

News and Views

SUPPLEMENTING our article entitled "Pleistocene Man in China" in NATURE of Dec 28, 1929, p 973, we are informed that Prof Davidson Black has cabled from Peking (or, as the Chinese Government now calls the city, Peiping) on Dec 28 as follows "Recovered Chou Kou Tien uncrushed adult *Sinanthropus* skull entire except face letter follows" This presumably is a correction of the unofficial cable grams that appeared in the newspapers on Dec 15 and 16 mentioning "a complete skull with both the cranial and facial bones perfectly preserved" Prof Davidson Black's promised statement was made at a meeting of the Geological Society of China held on Dec 28 According to a message in the *Times* of Dec 30 from its Peking correspondent, the credit for the actual discovery lies with a young Chinese geologist, Mr W C Pei, who is in charge of the field work of the Geological Survey at Chou Kou Tien Some four tons of fossils have been excavated, including parts of two lower jaws, several teeth, and cranial fragments of man Among the mammalian remains is included the sabre toothed tiger, which is contemporary with Peking Man The evidence would appear to point to a very high antiquity indeed Dr Grabau, of the Chinese Geological Survey, is said to assign the skull to the beginning of the Quaternary Age, while that well known authority on Chinese geology and archæology, Père Teilhard de Chardin, gives it an estimated antiquity of 400,000 to 500,000 years If either of these estimates is confirmed, it would place this relic at comparatively little later than *Pithecanthropus* of Java The skull is at present embedded in hard travertine, but the right side and vault have been freed by the removal of a relatively softer part of the matrix It would appear that while the whole of the facial region is lacking, the brain case is almost complete and massive jaw sockets have been exposed The brow ridges are also said to be massive As compared with the Java skull, the length is approximately the same, but relatively there appears to be greater brain capacity

WE propose to publish week by week throughout this year a calendar of historic natural events, and the first set of notes in this series appears on pp 32, 33 It is intended to include in the weekly record as wide a range as possible of remarkable natural occurrences and phenomena observed in past times Great storms, floods, frosts, and similar meteorological phenomena will naturally make up a large part of the collected events, and notable earthquakes, volcanic eruptions, and like terrestrial disturbances will also frequently come into the calendar Whatever has commanded scientific attention on the earth or in the heavens—including of course the appearances of new stars, bright comets, and meteor showers—will, it is hoped, be brought back to memory under their appropriate dates during the year Events in the natural history or biological field are more difficult to assign to particular dates, and we shall be grateful to any readers of NATURE who will assist us with references or notes upon remarkable occurrences of this kind Without such aid it will be difficult to make the historic records so comprehensive as we should like them to be

THE material for the calendar will be derived from a great variety of sources, too numerous to mention individually Special reference should be made, however, to the *Quarterly Journal of the Royal Meteorological Society*, the *Meteorological Magazine*, Dr C Easton's work, "Les hivers dans l'Europe occidentale" (Leyden, 1928), W Andrew's "Famous Frosts and Frost Fairs in Great Britain" (London, 1887), and a manuscript collection of extracts from the Saxon Chronicle and Holinshed's Chronicles, compiled by the late Miss Eleanor A Ormerod and now in the possession of the Royal Meteorological Society In compiling the records, the dates employed have been those of the actual calendar in use at the time It will be recalled that, in 1752, eleven days were added to the date in the British Isles, Sept 2 being directly followed by Sept 14, in order to bring the calendar into conformity with that introduced by Pope Gregory XIII

IN the second week of this month the centenary of the discovery of the Murray River by Captain Charles Sturt will be commemorated by representatives of South Australia, New South Wales, and Victoria, who will meet at Wentworth on Jan 7 The next day the delegates will witness the opening of No 6 Lock, near the Victorian border, and during the following week they will proceed down the river, unveiling memorials at historic spots, arriving at Hindmarsh Island on

Jan 19 Here the Deputy Governor of South Australia will unveil a granite column 40 feet high, with a bronze tablet, to commemorate Capt Sturt's landing place after his journey in a whaleboat down the river a hundred years ago Sturt, who was born in 1795 and was educated at Harrow, served in the Peninsula and in France, and in 1827 became military secretary to Sir Ralph Darling, the Governor of New South Wales He made several hazardous journeys into the interior, and in 1829 descended the River Murrumbidgee to its confluence with the Murray, and by the latter travelled to the coast His discoveries led to the founding of South Australia, of which Captain (afterwards Rear Admiral Sir John) Hindmarsh became the first Governor in 1836 Sturt afterwards became the assistant commissioner of lands and colonial secretary of the new colony, and one of the counties bordered by the Murray River bears his name He published accounts of his journeys and received the founder's gold medal of the Royal Geographical Society Sturt returned to England in 1853 and died at Cheltenham on June 16, 1869

THE Report on the Administration of the Meteorological Department of the Government of India in 1928–29 has recently been issued It covers the period during which the head office was reorganised and moved from Simla to commodious new buildings at Poona The opening ceremony which took place on July 20, 1928, is described in this report, and the speeches made on that occasion give a good conspectus of the present position and future prospects of the department The men who occupy the superintendentships of the various branches at headquarters are all Indians It is to them and their younger colleagues that we must chiefly look for new contributions to our meteorological knowledge of India during the next decade or so, and it is perhaps a good augury that the dislocation caused by the move has not prevented research work from being carried out during the period under review Some of those researches have already been reviewed in our columns

SIMLA was badly placed for three very important pieces of work Mr J H Field, the late Director General of the Department, had to conduct his pioneer work in the exploration of the upper atmosphere, by means of sounding balloons carrying self recording instruments, far from the central office, for balloons liberated at Simla are generally lost outright in remote parts of the Himalayas or in Tibet, carried eastwards in the circumpolar westerly circulation that is in evidence at high levels in northern India throughout a large part of the year An equally important line of investigation—the study of the tropical cyclones of the Arabian Sea—is also more readily conducted with Poona as a base Lastly, there is the forecasting of the monsoon, upon which the economic life of India is so dependent The rain bearing south westerlies from the far side of the equator reach Poona early, and in full strength, while Simla not only experiences them long after the greater part of India, but also as a 'wave' that has nearly spent its poleward impulse

THE Safety in Mines Research Board has come to the conclusion that its technical papers are somewhat too difficult for the ordinary miner to understand, and it has, therefore, commenced to issue a series of pamphlets headed "What Every Mining Man Should Know" The first two of these have now been published, and are priced at a very low sum (6*d* and 3*d* respectively) in order to make them generally available The first deals with research problems that have already been more or less completely solved and those that are now undergoing investigation, the object apparently being to bring before the ordinary coal miner the large volume of data which are as yet unknown and will have to be found out before coal mining can be made as safe as is humanly possible The second pamphlet is on gas and flame, and attempts to make clear to the unscientifically trained mind the rationale of gas ignition and gas explosion The authors have attempted to attain this object by photographs of a number of experiments, no doubt if the experiments could actually be seen, they would make the matter quite clear to the uninitiated, but it cannot be said that the photographs alone are equally conclusive Upon the whole, the effort, and especially the objects underlying it, are praiseworthy, unfortunately, it may be gravely doubted whether the great body of coal miners will be sufficiently interested even to read these pamphlets

DURING recent years there has grown up a general recognition of the value of international conferences This is especially evident in connexion with illumination, a subject which is in a state of constant development International co operation has been greatly fostered by the reconstitution of the original International Photometric Commission, on a wider basis, as the International Illumination Commission to which are linked national committees in all the chief countries of the world Since the War, meetings held in Paris (1921), Geneva (1924), Bellagio (1927), and New York (1928) have revealed continuous progress The conference held in the United States last year, which was attended by five hundred delegates from eleven different countries, was perhaps the most important ever held in connexion with illumination The next International Illumination Congress will be held in Great Britain on Sept 3–13, 1931, and will be combined with excursions to places of interest in England and Scotland Papers dealing with varied aspects of lighting will be presented, and topics of local interest will be dealt with at each centre The congress will be followed by the technical meetings of the International Commission on Illumination, which will be held in Cambridge on Sept 13–19 In Great Britain the machinery for the study of illumination is perhaps more perfectly organised than elsewhere, and the aid of all the leading scientific and technical bodies interested, and of organisations concerned with gas and electric lighting, is being secured The honorary general secretary of the Congress is Col C H Silvester Evans (c/o The Illuminating Engineering Society, 32 Victoria Street, London, S W 1), to whom all communications should be addressed

MR T G N HALDANE read a remarkable paper to the Institution of Electrical Engineers on Dec 19 He described a new method of producing low grade

heat from electricity by means of a device which he calls a heat pump In 1824, Carnot imagined a perfect reversible heat engine and proved that its efficiency is the ratio of the difference of temperature between the high and low temperatures of the working substance to the high temperature when the temperatures are expressed in the absolute scale If we imagine the Carnot engine reversed, that is, if it be supplied with mechanical energy, then a small amount of mechanical energy will allow a very much larger amount of heat to be pumped from the low source to the high source The general principle of this process was first pointed out by Kelvin in 1852 Little practical application has been made of it hitherto, possibly because it appears at first sight to contradict ordinary engineering principles Mr Haldane points out that the process of producing cold is simply that of pumping heat from a relatively cold to a relatively hot source Hence the refrigerator is the most familiar type of heat pump It is shown both from theoretical considerations and from practical tests on refrigerating plant that where heat at a comparatively low temperature is required, an 'efficiency' of the order of from 300 to 500 per cent can be obtained The heating efficiency is the ratio of the heat produced by the heat pump to the heat equivalent of the electrical energy expended The principle can be applied to the heating of large buildings and very usefully to the heating of public baths A description is given of experiments which demonstrate the soundness of the principles used Engineering estimates are given It appears that the heating of swimming baths is the most suitable field for the immediate application of the system

USERS of the telephone will find a paper, on interruptions on telephone conversations, by Mr K W Waterson, published in the *Bell Telephone Quarterly* (vol 7, p 166), both interesting and useful Every one has felt annoyance when a telephone conversation is suddenly interrupted by what is technically called a 'cutoff' It is small consolation to know that this only occurs about six times in a thousand Half of these are due to failure in human effort by the operators or to a fault in the extensive network connecting the two subscribers The other half are in private switchboards which are outside the company's control 'Cutoffs' on conversations from dial telephones occur less frequently than on connexions completed manually, as there is less opportunity for human error All long distance calls are subject to a greater risk of a cutoff In a long distance cable connexion from New York to Chicago there are 1500 relay or movable contacts and 9000 other fixed contacts of various kinds In addition, there are 40,000 soldered connexions in the toll line itself Considering the complication of handling the calls on a switchboard, the operator does well to keep his mistakes down to 1 in 1500, which is less than one in a day's work

THE errors due to the telephone subscriber generally arise when he trusts too much to his memory when calling a number, when he speaks indistinctly, or when, in the case of a dial telephone, he dials before hearing the dial tone During the last ten years the percentage of wrong numbers asked for by the subscribers has remained practically constant On the other hand, the wrong numbers attributable to the telephone company have diminished to half their former value At present it is difficult to see how the causes of 'bell rang' complaints can ever be eliminated However good the maintenance of the apparatus, it will occasionally get out of order, and however excellent the training and supervision, operators will sometimes err It is not always convenient for a subscriber to carry on a conversation the moment he is called, and the caller is often not able to wait until he gets a reply All efforts should be made to effect improvements in this direction

THE lure of spectroscopic investigation as applied to industry fascinates many a chemist until he reads a treatise, studies the subject in detail, and concludes that the goal is beyond his reach owing to high cost of equipment and the need for long training in the technique However far from or near to the truth this may be in the ordinary way, the reader will find his fears greatly reduced or even dispelled in a new publication entitled "Spectroscopic Outfits for Metallurgical Analysis" (4to, pp 40), published by Messrs Adam Hilger, Ltd Equipments of various types are so clearly described with regard to both their construction and the purposes to which they are adaptable, that the reader can scarcely fail to make a wise selection and to be assured that the cost will not greatly exceed the sum estimated, since accessories are listed together with the main equipment Part 2 opens up three new methods of quantitative spectrographic analysis, Barratt's twin spark photometric method, in which the unknown intensity of the given lines is adjusted to equality with that of known lines, Scheibe and Neuhäusser's method employing a 'rotating logarithmic wedge sector', which expresses in the length of the photographed line a function of its intensity, and Occhialini's method, also depending on measurements of the lengths of lines

SINCE the Arctic Islands of Canada were incorporated in the North West Territories of the Dominion, a great deal of exploration and survey work have been done annually, both in respect of routine patrols and in definitive pieces of investigation A small chart, published by the National Resources Intelligence Branch of the Department of the Interior, shows the routes of officers carrying out patrols, inspection, and investigation during the present year, by land and by sea Nearly the whole of the north west passage was visited, and extensive explorations were made in the little known Foxe peninsula, the eastern side of Foxe basin, and the northern coasts of Hudson Strait Most of the coasts of Baffin Island were visited, and in the far north patrols touched Melville Island, Bathurst Island, and Alex Heiberg Island, besides Ellesmere Island, where there is a police post The Department keeps in active touch with all the areas inhabited by Eskimo, and has made Canadian jurisdiction much more than nominal in these arctic territories

ON Dec 23, according to the *Times*, a memorial to Sir Stamford Raffles was unveiled in Batavia Born at sea, off Jamaica, in July 1781, Raffles at the age of

fourteen entered the East India house and in 1805 was sent to the Far East as assistant secretary of Penang Rising rapidly to more responsible positions, from 1811 until 1816 he was Lieutenant Governor of Java, where he abolished slavery, instituted schools, and in other ways ameliorated the lot of the natives His work, it was said, "will make his memory adored on the island of Java for ages to come" Afterwards Governor of Bencoolen in Sumatra, in 1819 he hoisted the British flag in Singapore He returned to England in 1824, where he founded the Zoological Society of which he was the first president His death occurred on July 5, 1826, and his statue was afterwards placed in the north aisle of the choir of Westminster Abbey

IN his address at the twelfth anniversary meeting of the Bose Institute, Sir J C Bose said that the advance of plant physiology had been obstructed by narrow specialisation His new type of 'growth balance' not only visualises imperceptible growth but makes an immediate measurement of the rate The establishment of the laws of growth, on which the advance of scientific agriculture depends, has been rendered possible by this new method Experiments carried out side by side on plant and animal tissue have established identical life mechanism in the two kingdoms The leg of the frog and the leaf of Mimosa produce similar motile response under nervous impulse caused by cathodic excitation of an electric current The characteristic effects of drugs are shown in automatic pulsations of both plant and animal Indian plants are being found having medicinal properties which were not previously suspected, and the efficacy of which in reviving the failing heart appears to be exceptionally high Further steps necessitate the isolation of the active principles from plant extracts as well as prolonged investigation for standardisation of dose on human subjects

IN the November *Scientific Monthly*, Prof M F Guyer describes the marine biological stations of Japan So much good work has come out of these institutions that it is interesting to have some general account of them, and the attractive photographs inspire one with a desire to work in these laboratories Two are described, the Marine Biological Station at Asamushi on the north eastern coast of the main Island of Japan, and the Misaki Marine Biological Station, which lies on the southern extremity of a peninsula which separates the Bay of Tokyo from Sagami Sea Both offer hospitality to foreign workers and both have much to offer in interesting plants and animals and ideal collecting grounds The Asamushi Station has a staff of fourteen, with Prof Hatai as director There is a well equipped laboratory and aquarium and an under sea laboratory which is half submerged The Misaki Station was founded by the Japanese Government in 1887 at the suggestion of Prof Mitsukuri It is now under the direction of Prof Yatsu of the Tokyo Imperial University The wonderful fauna and flora of this part of the world is well known for its richness, and regular courses are given for teachers in fisheries, planktology, and oceanography Here also the laboratory is well equipped, and there is a library and aquarium, besides research rooms for investigators Both of these stations are of the greatest possible value

THE question of growing crops subsidiary to the staple products of a country is discussed in a recent issue of the *Bulletin of the Imperial Institute*, vol 27 p 307, with particular reference to the tropical colonies The danger of depending solely on one crop has recently been emphasised by the occurrence of a slump in the tobacco industry in Rhodesia, Nyasaland, and elsewhere, but many factors notably transport, need to be considered before a suitable subsidiary export crop is selected The industry suggested is the manufacture of essential oils, of which peppermint, geranium, and lavender appear the most promising The oil is prepared from the plants by steam distillation, the process being carried out by the grower on the spot A full account of the different varieties the methods of cultivation, harvesting, and preparation of the oil, is given for each plant, together with the average yields to be expected and the present market conditions Co operation with the Royal Botanic Gardens at Kew is being arranged plants for trial cultivation being sent to certain areas and the resulting oil being returned to the Imperial Institute for analysis and valuation For those desiring further information a list of useful references is appended, the Imperial Institute is prepared to advise planters with regard to the type of still required and to put them into touch with makers of the necessary apparatus and merchants through whom the oils may be marketed Intending planters are, however, also recommended to consult the agricultural officers of the country concerned so that they may obtain advice based on a thorough knowledge of local conditions

THE growing appreciation of the value of trade associations for protecting the interests of their members is exemplified by the formation of the British Disinfectant Manufacturers' Association, the inaugural meeting of which was held on Dec 16 last About fifty firms, representative of all the branches of the disinfectant trade, have signified their intention of joining the new Association One of the main objects of the Association is to protect and further the mutual trade interests of its members, to foster the manufacture of British disinfectants and promote closer co operation between British disinfectant manufacturers The Association will also serve as a medium for placing before government departments or other public bodies, at home and abroad, the views of British disinfectant manufacturers on matters affecting their industry Mr N F Kingzett, of the Sanitas Co, Ltd, was elected chairman, Mr W H Hivey, of Taylor's Automatic Disinfector, Ltd vice chairman and Mr R A Blair of Burt, Boulton, and Haywood Ltd, honorary treasurer of the new Association, which will be affiliated to the Association of British Chemical Manufacturers, 166 Piccadilly W 1 The Association has already taken steps to investigate certain questions of tests which have arisen in connexion with the standardisation of disinfectant specifications by a government committee

We much regret to announce the death, on Dec 25, of Major P A MacMahon, F R S, president in 1917–19 of the Royal Astronomical Society, who was formerly Deputy Warden of Standards, Board of Trade, at the age of seventy five years, also of Major P H Hepburn, president in 1920–22 of the British Astronomical Association and treasurer in 1927–28 of the Royal Astronomical Society, on Dec 25, aged fifty six years

The fourteenth series of "Methods and Problems of Medical Education" has been issued by the Rockefeller Foundation, New York Methods of keeping records are dealt with in this series, and as models specimens of the following are given (1) the complete case sheets of a case of fracture, Massachusetts General Hospital, (2) the blank forms used in a sanitary survey, Peking Union Medical College, and (3) a summary of the records and record system of the Children's Hospital, Cincinnati, Ohio

Applications are invited for the following appointments, on or before the dates mentioned —A principal of the County Technical College and School of Art, and organiser of evening school work in the Borough of Newark—The Clerk to the Governors, Education Offices, Old Magnus Buildings, Newark (Jan 14) A principal of the County Technical Institute, Worksop—The Director of Education, Shire Hall, Nottingham (Jan 25) A lecturer in physical and stratigraphical geology in the Egyptian University, Faculty of Science, Cairo—The Dean of the Faculty of Science, Egyptian University, Cairo (Jan 31)

Our Astronomical Column

An Active Region on the Sun —Although the maximum of the present cycle was reached in 1928, the sun has shown considerable activity during the past three months in the appearance of several large spots (see Nature, Oct 19, p 631, Nov 9, p 737, Dec 7, p 888, Dec 28, p 998) During the latter part of December, another group of spots crossed the disc, covering with its attendant faculæ a great extent of the sun's surface The group (or possibly two separate but allied groups), which consisted of a long stream extending over 18° of longitude or 130,000 miles, occupied the place of the big naked eye spot, No 16 of the previous rotation, which also was the return of a complex stream beginning its development on Oct 30 Notes relating to the early history of this active region are given in the *Observatory* for December last, p 365

The present group was observed at Greenwich with the spectrohelioscope presented to the Royal Observatory by Dr Hale, and it was seen to be associated with extensive bright hydrogen flocculi Preceding the group, on Dec 24–26 (the only days when observation was possible), there was a very long, slender, dark filament which represented a prominence of considerable size and activity Measures taken with the velocity recorder or 'line shifter' of the spectrohelioscope showed on Dec 25 a difference of 95 km / sec in radial velocity between the two ends of the filament, the southern end rising from the sun with a velocity of 25 km /sec and the northern end falling back with a velocity of 70 km /sec A detailed account of a similar observation of a dark filament but connected directly with a sunspot is given by Dr Hale in Nature of May 14, 1927, p 711

The following table completes the list of large sun spots seen during the year 1929

No	Date on Disc	Central Meridian Passage	Latitude	Maximum Area
19	Dec 21–Jan 2	Dec 27 5	16° N	2000

Comets —A new comet, 1929*d*, was discovered on Dec 20 by Mr Wilk of Cracow Observatory, who will be remembered as one of the discoverers of comet 1925XI (Peltier Wilk) The following positions, of which the first is only approximate, have been transmitted by telegram from the I A U Bureau, Copenhagen

U T	R A 1929 0	N Decl 1929 0	Observer	Place
Dec 20d 17h 45m	18h 8m 35s	36° 19	Wilk	Cracow
21 17 32 1	18 20 15 67	35 23 30	Wolf	Königstuhl

The magnitude was noted as 7 on Dec 20, 9 on Dec 21 The deduced rate of daily motion is $+11^m\ 48^s$, $-56'$ This gives the rough position for the evening of Dec 28, R A $19^h\ 43^m$, N Decl 28° 52′, which is some 5° east of β Cygni This is the first comet readily visible with small instruments in European latitudes for nearly two years, and the first orbit likely to prove parabolic since the bright comet 1927IX (Skjellerup)

As the comet is approaching the sun, though receding from the earth, it is likely to become somewhat brighter the following positions were secured by Dr W H Steavenson at Norwood

		R A 1929 0	N Decl 1929 0
Dec 25	18 37 3 U T	19h 5m 36 64s	30° 42′ 14″
„ 26	18 21 0 „	19 15 47 91	29 24 37

Prof Banachiewicz, Director of Cracow Observatory, has deduced the following orbit from observations on Dec 21, 23, 25

$$\begin{array}{ll} T & 1930 \text{ Jan } 22\,257 \\ \omega & \left.\begin{array}{l} 157^\circ\ 8' \\ 178\ \ 41 \\ 124\ \ 31 \end{array}\right\} 1929\,0 \\ \Omega & \\ i & \\ \log q & 9\,82840 \end{array}$$

Ephemeris for 18h U T

	R A	N Decl	log r	log Δ
Jan 1	20h 9m 50s	21° 1′	9 9006	9 9789
„ 5	20 38 1	15 24	9 8783	0 0054
„ 9	21 1 4	10 8	9 8586	0 0359
„ 13	21 19 45	5 18	9 8430	0 0679
„ 17	21 34 51	1 3	9 8328	0 0990

An observation by Dr A C D Crommelin on Dec 29, not yet fully reduced, shows that the position was within 1′ or 2′ of the ephemeris place, so that the elements are probably near the truth the comet must be looked for in the evening as soon as the sky is dark enough

Prof van Biesbroeck followed Forbes's Comet, 1929*c*, at Yerkes Observatory until Nov 22 on Nov 5 it was of mag 15, with a diffused nucleus and a tail on the following side On Nov 22 the magnitude was 16 5 He is still following Stearns's Comet, 1927IV, with the 24 inch reflector Its magnitude is 16 Carpenter's reported comet of Nov 2 may be written off as unconfirmed

Research Items

The Earliest Civilisation of Egypt.—In *Antiquity* for December, Mr. Guy Brunton gives a brief account of the progress of excavation at Badari since it was initiated in 1922. He sketches in outline the civilisation of the Badarians so far as it can be reconstructed from the evidence, dating it approximately at 5000 B.C., going on to describe the differing and, it is suggested, earlier culture of the Tasians, discovered in the expeditions of the last two years. Certain points differentiate them sharply from the Badarians. The typical form of pottery is a jar having a small flat base, wide mouth, and a rather sharp angle at the bulge. The ware is greyish with black patches, and shows a vague coarse rippling which is vertical. There is sometimes a definite irregular black band around the rim. Associated with these people are beaker pots with broad flaring mouths and incised designs filled with white. Two more or less whole and many fragments come from the village sites, none so far from graves. In five places they have been found with polished celts, either of hard limestone or greyish green igneous rock. The Tasians are definitely connected with the celts by an undisturbed grave at Deir Tasa, in which was typical Tasian pottery. A poor example of the beaker was found in a Badarian grave at Qau in 1923, and may indicate an overlap of the two cultures. The Tasian culture is more primitive than the Badarian, and everything points to its being earlier. A few skulls have been found in good condition. They are rounder than the pro-dynastic or the Badarian, and have broad faces and square jaws quite unlike the Badarian. The graves are wider and deeper than the Badarian, with a niche in the side to take the pot.

Change in an African Society.—In the *Sudan Notes and Records*, vol. 12, Part 1, Mr. G. O. Whitehead publishes a study of the social organisation of the Bari, with special reference to the changes which have taken place comparatively recently in the status of the various social groups. The Bari were formerly composed of freemen, *Lui*, and servile groups, collectively called *Dupi*. The *Dupi* proper were serfs who cooked, and were of a physique markedly distinct from their masters. They did not own cattle, but are supposed to have lost them to the freemen. Yet they had to pay cattle on marriage, these being obtained from their masters. For this the masters had a claim on their services. Probably they were racially distinct from the freemen who had conquered them when they invaded the land. Other classes were the hunters, neither owning cattle nor cultivating land. They paid tribute to their chief. Two other classes were the Artisans of the Forge and the Artisans of the River, each living in separate villages. They were not so servile as the *Dupi*. They had few or no cattle, yet married independently of their chief's assistance owing to the value of the goods they produced. The introduction of money, the increase in agriculture, and disturbance due to unrest in the Sudan have brought about a redistribution in the ownership of cattle, which no longer belong exclusively to the *Lui*, and a dislocation of the pastoral life. This has blurred the hard and fast lines between the classes. The *Dupi* no longer depend on the *Lui* for their marriage arrangements, while under European control the position of the chief is changed and depends upon the relation with the Government rather than his own intrinsic position. The advice of the fathers of the soil is no longer listened to as it once was.

Yellow Fever Vaccine.—Stokes, Bauer, and Hudson in 1927 made the important discovery that Asiatic monkeys, particularly *Macacus rhesus*, can be readily infected with yellow fever, and that the disease may be maintained in these animals either by direct inoculation of infected blood or tissues, or by mosquito transmission. By this means, Hindle has been able to maintain and propagate the virus in London for more than a year, and through a large series of animals (*Trans. Roy. Soc. Trop. Med. and Hyg.*, 22, p. 405, 1929). Hindle finds that a suspension of the ground and cytolised liver and spleen taken from an animal *in extremis* will produce infection in a dilution of 1 : 10,000, but if to the suspension two parts of formaldehyde per thousand are added and the mixture is kept in the ice chest for twenty-four hours, virulence is lost and the material may be used as a preventive vaccine. A monkey inoculated about ten days previously with this vaccine resists a dose of 1000-10,000 minimal lethal doses of active virus, and the immunity produced lasts for more than six months, the longest period so far tested.

Snakes of Ceylon.—A useful paper, by L. Nicholls, deals with the simpler recognition marks of the land snakes of Ceylon (*Ceylon Jour. Sci.*, Sect. D, vol. 2, Pt. 3, 1929, p. 91). Since every year deaths in Ceylon are attributed to non-poisonous snakes, the diagnoses have been arranged so that medical men may have at hand a ready means of determining any species and its possible harmfulness to man. In all, 61 species are described, 14 of which are earth snakes, 1 a constrictor, 42 colubrids, and 4 vipers. So far as possible, technically difficult descriptions have been avoided and identification rests for the most part on the external characters of coloration, markings, and general appearance, and simple scale characters.

Teleostean Fishes of Tortugas.—Mr. E. W. Gudger ("On the Morphology, Coloration, and Behaviour of Seventy Teleostean Fishes of Tortugas, Florida." Papers of the Tortugas Laboratory of the Carnegie Institution of Washington, vol. 26, No. 5) gives an account of his observations on various fishes. The work is specially valuable as it has to do mainly with living material, giving details of the colouring, variation, and habits both in natural surroundings and in the aquarium. Special stress is laid on the importance of the variability in colouring. The fishes also vary much in number of fin rays, scales, and relative proportions of the body. The small clupeoid *Jenkinsia stolifera* is present in schools of many thousands, often swarming round a large grey snapper, leaving a space round it and moving when it moves, only to rearrange themselves in the same way when it comes to rest. The account of the feeding habits of the grey snapper itself is interesting. *Apogonichthys puncticulatus* was found swimming inside the mouth of the shell of a large conch (*Strombus bituberculatus*), and probably lives symbiotically with this mollusk, in the same way in which *Apogonichthys strombi* lives in *Strombus gigas* as described by Plate from the Bahamas. Anatomical details of many of the fishes are given, including many notes on the internal organs besides the external features.

Gonophores of *Myriothela*.—E. A. Briggs (*Records Austr. Mus.*, vol. 18, 1929) describes the gonophores of *Myriothela australis*. All the gonophores on one individual are of the same sex; they are spherical when mature, supported on narrow cylindrical peduncles

arising from the sides of the blastostyles The male cells are derived from cells on the floor of the sub umbrellar cavity, and the first stage in spermato genesis begins in the mass of cells covering the spadix The secondary spermatocytes derived therefrom fill the subumbrellar cavity At the distal pole of the gonophore, the ectoderm becomes invaginated to form the velar aperture, which breaks through into the subumbrellar cavity, and permits the escape of the sperms In the female gonophore the cells of the germinal mass are arranged in several layers, the outer of which forms the external epithelium of the future spadix, and the others are the reproductive cells and form the oogonia These multiply and finally fill the space between the manubrium and the subumbrellar epithelium The oogonia give rise to primary oocytes, and here and there two of these come into contact and their cytoplasm fuses The fusion products in crease by accretion of other similar ones or of primary oocytes The end result is that in the gonophore are five or six plasmodial masses separated by non cellular partitions The large definitive egg is pro duced by the withdrawal of these partitions and the fusion of the plasmodia, and becomes charged with yolk At the distal pole of the gonophore is the velar aperture through which probably the sperm enters

***Cardita beaumonti* Beds of Sind** —The *Cardita* [or *Venericardia*] *beaumonti* beds as they occur in Balu chistan were treated of by M Henri Douvillé in a previous paper (see NATURE, Oct 6, 1928, p 552), and he now deals with them as developed in Sind (*Pal Ind*, New Series, vol 10, mem 3, fasc 2) The fauna of these beds in Sind is definitely marine, as evinced by the abundance of Nautili and Fusidæ, whereas in Baluchistan more brackish water forms, and particularly Melaniidæ, prevail Stratigraphical evidence shows that in Baluchistan the beds represent the lower Danian, whilst in Sind they are at the top and underlie the basaltic trap of the Lakhi hills Many of the Sind species differ solely in specific characters from Eocene forms Just fifty species of mollusca are described, half of which are held to be new and illustrated on eleven photolitho plates, which, considering the nature of the objects depicted, are remarkably good

Petrographic Nomenclature —In the *Travaux du Musée Minéralogique près l'Académie des Sciences de l'U R S S*, vol 3, 1929, Dr Belliankin gives an inter esting discussion (in English) of the meaning of the term 'rock' He arrives at the definition 'Rock is a mineral body, homogeneous in matter and struc ture", where 'mineral body' includes aggregates of one or more minerals, mineral mixtures or glasses From this it is deduced that the classification and nomenclature of rocks should be primarily minera logical Belliankin points out that geographical names are not suitable, and that "a text book of petro graphy turns out to be a certain kind of universal manual of geography" As a concrete suggestion for a practicable alternative, he proposes to name rocks from the first syllables of the names of their dominant minerals For felspathoidal rocks he thus arrives at the following names, based on the abbreviations italicised in *ægi*rine, *py*roxene, *di*opside, *titan py* roxene, *am*phibole, *bar*kevikite, *bi*otite, *ne*pheline, *so*dalite, *no*sean, *ana*lcite, *meli*lite

Geographical Names	*Rational Names*
Urtite	Leuco ægineite
Ijolite	Ægineite
Melteigite	Melano ægineite
Monmouthite	Amnite
Congressite	Bineite
Tawite	Ægisodite
Naujaite	Anam ægisodite
Bekinkinite	Barneite
Fasinite	Tipyneite
Riedenite	Pynosite
Turjaite	Binemelite
Uncompahgrite	Dimelite

The suggestion is an excellent one, it deserves serious discussion at the next International Congress of Geology

Wave-Mechanics of α-Ray Tracks —In a note in the December number of the *Proceedings of the Royal Society*, Mr N F Mott discusses the apparent con tradiction between the wave mechanical theory of radioactive disintegration, according to which an α particle leaks out from its parent nucleus as a spherical wave, and its particle like attribute of leaving an almost linear trail in a Wilson cloud chamber The discrepancy is, of course, only appar ent The wave of the α particle must not be con sidered by itself, but as contributing to a wave-function in a space of many dimensions formed by the co ordinates both of the α particle and of every atom in the expansion chamber Mr Mott develops the appropriate theory for the case when there are two atoms of hydrogen present, and finds that both must lie within a cone of small angle having its apex at the radioactive nucleus, if they are both to be ionised In other words, the α particle should, apart from collisions with atomic nuclei, leave an almost straight trail Mr Mott's paper is an elaboration of one of the points raised by Prof C G Darwin in his paper on collision problems in wave mechanics in the June issue of the *Proceedings*

Measurement of Refractive Indices —A rapid method for investigating the dispersion of liquids is described by Prof T M Lowry and Mr C B Allsopp in the December number of the *Proceedings of the Royal Society* A small quantity of the substance is enclosed in a quartz etalon, and the interference fringes formed in the film in parallel light are focused on to the slit of a spectrometer, when the variation in fringe width in passing along the spectrum—photographed in the usual way—leads readily to a knowledge of the dispersion in the liquid The accu racy obtainable is not so high as in some methods, being largely limited by the number of fringes which can be thrown on to the slit, but the device of working with thin films in quartz makes it possible to follow the dispersion curve of even poorly transmitting substances well into the ultra violet, and the informa tion so obtained is very complete A curve for nicotene, which was obtained without very elaborate precautions in the control of temperature, is repro duced in the paper, and extends to 2900 A hollow prism methods could only be used down to about 4300 A, below which it was impracticable to proceed, because of absorption in the liquid

Photoelasticity —In the first part of volume 12 of the *Scientific Papers* of the Institute of Physical and Chemical Research, Tokyo, Mr Z Tuzi describes a new method of studying the elastic stresses in struc tures by means of the kinematograph A model in phenolite is placed between crossed nicol prisms through which monochromatic green light is sent The light and dark bands produced by the stressed specimen are photographed either in the usual way with a steady load or on a kinematograph film during the application of the load Photographs of the bands produced when the steel side of a railway carriage with its doors and windows is loaded at nine points on its top edge, are reproduced for a steady load and

for its gradual application, and are remarkably clear The stresses are calculated from the photographs and are compared with the values calculated by the approximate methods used in designing the carriage The agreement is not satisfactory, and the author gives more accurate methods of calculation which agree better with the experimental results

Shearing and Punching Metals—More than 110 pages of the *Bulletin* of the Société d Encouragement pour l'Industrie Nationale for July August September are devoted to M Charles Fremont's account of his researches on the shearing and punching of metals, which have been carried out with the support of the Society He has investigated the influence of the form of the shears or punch on the work which has to be done in the shearing or punching process, and by means of photomicrographs determined the distortion the material undergoes The 268 figures add greatly to the interest of the memoir

Precipitated Selenium Dioxide—In the November issue of the *Journal of the American Chemical Society*, Hoffmann and Lenher show that the precipitate formed by the action of ozonised oxygen on a solution of selenium in selenium oxychloride is selenium dioxide The density of the precipitated dioxide is appreciably lower than that of the sublimed substance, although the molecular weights of the two were found to be identical The precipitated dioxide absorbs dry hydrogen chloride to form a fuming, straw coloured liquid similar in composition and density to selenium hydroxychloride No evidence of the existence of selenium trioxide or chloroselenic acid was found

Union of Hydrogen and Chlorine—When a mixture of equal volumes of hydrogen and chlorine is exposed to white light of constant intensity, combination occurs more slowly in narrow capillary tubes than in wider D L Chapman and Grigg, who discovered this effect, explained it by assuming that the combination is due to an unstable catalyst which is destroyed in contact with glass or a film of water In the November number of the *Journal of the Chemical Society*, they describe further experiments which show that the mean life of the catalyst is of the order of magnitude of the time taken by the catalyst molecules to reach the surface, although there are some points in which the theory proposed is not closely followed The mean life always increases with decreasing pressure, which seems to show that one or both of the reacting gases have an inhibitive effect, a conclusion which is supported by an observation of M C C Chapman that hydrogen can act as a weak inhibitor The results are consistent with those of Weigert and Kellermann, published in 1923, these authors being the first to attempt to estimate the life of the catalyst which is formed when the gas is exposed to light The experiments give no indication as to whether this catalyst is a chain of alternately formed chlorine and hydrogen atoms, as postulated by Nernst and Bodenstein, or unstable nuclei of unknown structure

Glycogen—Glycogen is a peculiar material very similar to starch which is found in the livers of mammalia It is coloured wine red by iodine In the November number of the *Journal of the Chemical Society*, Haworth, Hirst, and Webb describe some preliminary experiments with glycogen which indicate that the hypothesis supported by Karrer, that starch and glycogen are similarly constituted, both structurally and configurationally, is correct. The difference in the colour reaction with iodine may be distinctive, but it is possible to prepare a starch fraction which gives the same colour as glycogen In accordance with modern views, glycogen is assumed to be constituted on the basis of continuous maltose units, that is, of a conjugated chain of a glucose units The difference in properties of the two substances is supposed to be due to a difference in size of their respective micelles The experiments involved acetylation of glycogen with acetic anhydride, in presence of either chlorine or sulphur chloride as catalysts or of pyridine, when the triacetate was obtained in almost quantitative yield as a white powder Although this was denser than starch triacetate the two products showed nearly the same optical rotation in chloroform solution Deacetylation gave a regenerated glycogen having all the characteristic properties of the original polysaccharide Similar results were obtained by methylation following simultaneous deacetylation of the two triacetates

Experimental Cold-rolling Mill—The invention of rolls for metal working dates back at least so far as the twelfth century, probably being used then for producing gold strip Leonardo da Vinci was the first to suggest their use for heavier work, but the rolling of iron did not come in until the eighteenth century The Swedish man of science and engineer Triewald had a rolling mill with 10 inch rolls, but it was in England that the mill was fully developed and rolling both hot and cold is widespread To further the study of the cold rolling of steel and other metals a cold rolling mill has been placed in a new laboratory attached to the metallurgical and engineering departments of the University of Sheffield, (see NATURE July 13 p 66) The machine, constructed by Messrs W H A Robertson and Co, Ltd, of Bedford is described in *Engineering* for Dec 6 The rolls of Hadura alloy steel made and presented by Messrs Hadfields, Ltd, are 10 in diameter by 10 in face and are suitable for the cold rolling of strip up to 6 or 7 inches wide Special attention has been given to the cooling of the rolls and the lubrication of the bearings, and the rolls are driven by an electric motor of 50 120 h p, giving a speed of anything from 59 3 ft to 300 ft per minute A good deal of the work done will naturally be in the direction of metallurgical research, but it is hoped that opportunity will be taken to obtain reliable data on the effect of rolling speed on power consumption, accuracy, etc, matters of the greatest value to the industry

Fuel Tests—Canada's resources in fuel are abundant, but the distribution is unfortunate Ontario and Quebec rely largely on anthracite from the United States This dependence has been inconvenient in recent years owing to recurrent shortages, and many substitutes have been tried In order to determine the relative value of these, the Dominion Department of Mines has instituted a series of "Comparative tests of various fuels when burned in a domestic hot water boiler", reported by E S Malloch and C E Baltzer (*Report* No 705 Ottawa F A Acland, 1929, 20 cents) These tests were carried out with great elaboration and on thirty fuels of the most varied type, ranging from anthracite to peat, consumed in a typical domestic appliance and for house heating The most efficient fuel tested was Welsh anthracite, 8 4 tons of which was equal to 10 tons of American anthracite, taken as standard Scotch semi anthracite was nearly as good The tests showed that more than 70 per cent of the heat of anthracites and cokes could be transferred to the water With semi bituminous coals 65 per cent, and with low grade fuel less than 55 per cent, of the heating value of the fuel could be utilised The results should be very encouraging to those interested in the export of British coals

Nickel Steel in the *Golden Arrow.*

THE publications of the Bureau of Information on Nickel of the Mond Nickel Co, Ltd, have from time to time provided most valuable information on many different aspects of the use of nickel in all types of metallurgical and engineering activity Paper A, No 4, recently issued, deals with the use of nickel steel in the *Golden Arrow*, in which Sir Henry Seagrave attained an average speed in two runs in opposite directions of 231 36 miles per hour

The whole of the main and sub frames of the *Golden Arrow* were made of a nickel steel containing 3 5 per cent of nickel and 0 3 per cent of carbon, and it is of interest to note that the side members, which were 19 ft 6 in long, were pressed in one length The very extensive use of this steel, which incidentally was largely used in the brake equipment, indicates its dependability and the wide range of properties obtainable from it with different heat treatments In the normalised condition it will give a tensile strength of 35 tons per square inch, together with 25 per cent elongation A 1¼ in diameter bar oil hardened from 840° C and tempered at 550° C gave a yield point of 42 tons per square inch, a maximum stress of 55 tons per square inch, an elongation of 25 per cent, a reduction of area of 61 per cent, and an impact figure of 56 ft lb

For the main parts of the axles, where a particularly strong material was needed, a nickel chrome molybdenum steel of the following composition was chosen Carbon 0 3 per cent, manganese 0 4 per cent, nickel 3 5 per cent, chromium 0 65 per cent, molybdenum 0 2 per cent This material, which was also used for the gears, gives in the heat treated condition a yield point of 56 tons per square inch, a maximum stress of 63 tons per square inch, 20 per cent elongation, 60 per cent reduction of area, and an Izod value of 67 ft lb This steel gives exceptional uniform properties throughout its cross section when properly heat treated, which, no doubt, influenced the designer in his selection

A 5 per cent nickel case hardening steel containing about 0 1 per cent of carbon was extensively used for parts subject to considerable wear, such, for example, as the swivel pins Refined at 830° C and quenched from 760° C, the approximate tensile figures given are Maximum stress 55 tons per square inch, elongation 15 per cent, reduction of area 40 per cent, with an impact value of 20 ft lb For several parts of the steering mechanism where the stresses involved may be exceptionally high, a nickel chrome molybdenum steel of the following composition was chosen Carbon 0 25 per cent, manganese 0 5 per cent, nickel 3 per cent, chromium 1 2 per cent, molybdenum 0 2 per cent In the quenched and tempered condition, the mechanical properties obtained from this steel are Yield point 62 5 tons per square inch, maximum stress 69 tons per square inch, elongation 19 5 per cent, reduction of area 61 5 per cent, impact value 54 ft lb

For the clutch casing, cover plates, and certain small levers, a nickel chrome steel was specified containing 0 3 per cent of carbon, 3 5 per cent of nickel, and 0 6 per cent of chromium When hardened in oil from 830° C and tempered at 600° C the material gave Yield point 49 tons per square inch, maximum stress 58 tons per square inch, elongation 22 per cent, reduction of area 55 per cent For the clutch centre, withdrawal sleeve, and several other details, a high tensile case hardening steel containing 3 5 per cent of nickel and 1 per cent of chromium was employed After carburising, the steel was given two quenching treatments, one from 830° C and one from 770° C, and afterwards tempered at 200° to obtain a maximum toughness The properties of this material in the form of a 1¼ in diameter bar were Yield point 55 tons per square inch, maximum stress 69 tons per square inch, elongation 15 per cent, reduction of area 45 per cent, and impact value 28 ft lb

It will be appreciated that, apart from the use of nickel steels, the construction of this machine would have been impossible

Investigations in Greenkeeping Problems.

THE St Ives Research Station, Bingley, Yorkshire, which has been established by the British Golf Unions for the purpose of studying greenkeeping problems from the scientific aspect, has issued the first number of the *Journal* of the Board of Greenkeeping Research The development and organisation of the scheme are explained in a foreword, and an interesting account is given by the Director, Mr R B Dawson, of the surroundings and historical associations of the St Ives estate A general discussion follows of the kind of problems confronting the greenkeeper and the line of attack to be undertaken in their solution The station has an ambitious programme, and useful work has already been accomplished

It is realised that the present condition of a turf is largely due to its previous treatment, and that much valuable knowledge may be obtained by collecting and classifying existing information All those interested are invited to contribute their experiences for this purpose An advisory system is already active and a special feature of the *Journal* will be the publication of inquiries dealing with problems of general interest, together with their respective replies Excellent examples of such correspondence are given in the first number

The choice of site for the research station has been fortunate There is a wide range of soils within the relatively small confines of the estate, and further, a difference in elevation from 300 ft to 900 ft is available More than three acres of adjoining land have been acquired and some 400 plots are to be set up to determine the best conditions, both manurial and cultural, for the production of first class putting greens for comparative tests with selected seed mixtures, and for vegetative propagation trials of other grasses, notably *Agrostis canina*, which produces stolons The use of stolon forming grasses for lawns in India is the subject of a further article of interest

Greenkeeping problems have changed considerably in recent years, owing largely to such alterations in practice as the use of compost in place of the heavy roller, and by the introduction of mowers of improved design and numerous chemical fertilisers Hitherto, agricultural methods have usually been employed, and too often the supposition that what is suitable for pasture is equally good for the golf green has proved a fallacy A special type of turf is required for greens free from coarse grasses, weeds, and worm casts For this purpose the effect of various fertiliser treatments will be determined and a thorough, unbiased investigation of the so called acid theory, which maintains that the type of turf required is obtained under acid soil conditions, will also be undertaken Consideration will be given to climatic, physiographic, edaphic, and biotic factors

For the success of the work it is essential that the various golf clubs themselves should give their hearty co operation and such financial support as they are able Later, it is hoped to increase the scope of the work and to extend the investigations to the problems of turf culture peculiar to other sports

Canadian National Research Laboratories

TENDERS have been invited by the Government of Canada for the construction of a National Research Laboratories building that will cost, when finished, approximately three million dollars (Fig 1) Appointment of chiefs to two of the laboratory divisions has been announced

Dr H M Tory, formerly president of the University of Alberta and now the president of the National Research Council, has expressed the view publicly that the new home for research in Canada will be one of the finest to be found in any country It is being built on the banks of the Ottawa River in the capital city Designed in the form of a giant figure ' 8 ', it will stand 60 feet (four stories) high, 418 feet long, and 176 feet deep Two hundred and fifty thousand feet of floor space will be provided Library accommodation will be for 300,000 volumes An assembly hall and associated rooms will be capable of accommodating the staff and the various scientific societies of the Dominion

FIG 1 —Architect s model of the National Research Laboratories building to be constructed by the Government of Canada in the capital city of Ottawa

Plans call for the development of the following divisions the divisions of physics and engineering physics, to the head of which Dr Robert William Boyle, dean of the faculty of applied science at the University of Alberta, has already been appointed, the division of industrial chemistry, to the head of which Dr George Stafford Whitby, professor of organic chemistry at McGill University, has been appointed, the division of economic biology and agriculture, to which Dr Robert Newton professor of field crops and plant bio chemistry at the University of Alberta, is the acting head, the division of industrial engineering, the division of textiles, the division of standards, and such other divisions as improvement in industrial processes, the development of natural resources, and the utilisation of waste require

Dr Boyle was graduated from McGill University in 1906, and from then until 1909, when he received the Ph D degree and the 1851 scholarship, he did research on the properties of matter and radioactivity From 1909 until 1911 he continued his work under the direction of Sir Ernest Rutherford at the University of Manchester Returning to Canada, he lectured at McGill, was appointed assistant professor in 1912, and the same year was made professor in the University of Alberta During the War years, on the recommendation of Sir Ernest Rutherford, Dr Boyle was engaged in research for the Admiralty Board of Invention and the anti submarine division, and in that work he developed important applications of ultra sonics In 1924 he tested apparatus for the detecting of icebergs and the sounding of depths in the Belle Isle Straits

Dr Whitby studied chemistry under Sir William Tilden at the Imperial College of Science and Technology, London, graduating in 1906 with the Frank Hatton prize He was one of the first scientific workers to study the rubber industry, and one of his books thereon, Plantation Rubber and the Testing of Rubber", 1920, has markedly influenced the trend of rubber research In recognition of his contribution in that field, the Institution of the Rubber Industry (Great Britain) recently awarded him the Colwyn gold medal In 1928 the distinction of Officier d Académie was conferred upon him by the Government of France The same year he was president of the Canadian Chemical Association

As assistant director of the division of physics and engineering physics, Prof John Hamilton Parkin, associate professor of mechanical engineering at the University of Toronto, has been appointed to direct the development of national aeronautical research laboratories

Plans for the new National Laboratories building call for completion early in 1931 Meanwhile, temporary laboratory space has been provided

University and Educational Intelligence

EDINBURGH —Dr Alexander Nelson, formerly superintendent of research in the Department of Agriculture in Tasmania, has been appointed lecturer in the Department of Botany and Dr W H McCrea, formerly senior scholar of Trinity College and Isaac Newton fellow in the University of Cambridge, has been appointed lecturer in the Department of Mathematics

MANCHESTER —Prof H J Fleure professor of geography and anthropology in the University College of Wales, Aberystwyth, has been appointed professor of geography

THE Carnegie Foundation for the Advancement of Teaching published in its last annual report an account of an educational inquiry differing from those which

it has hitherto undertaken or promoted, in that it involves tracing the progress of individual students throughout their careers in secondary schools and in college Previous studies have presented in cross section pictures of a situation at a selected time without regard to what went before or followed in the experience of the individual student The investigations, which will necessarily be prolonged through a period of ten years, will embrace the work done in most of the secondary schools and fifty colleges in Pennsylvania, and will, it is hoped, throw light on the validity of currently used methods of classification of pupils according to abilities and interests, on the degree of consistency to be looked for in normal educational growth, and on the actual efficiency of secondary and higher institutions in the organisation and administration of courses of study, the evaluation of educational products, and the rewarding of student effort In tracing the progress of individual students through college, material will, it is thought, be obtained for dealing with difficulties resulting from the kaleidoscopic nature of the elective curriculum and the bewildering variety of personal contact and advice, much of it of a partisan character, to which the college entrant is exposed Much might be done, it is suggested, in "initiating vigorous, wholly avowed and official measures to *understand* the student, and thus to discharge primary obligations of the college" Other matters of general interest in the report are reviews of the rise and present position of endowed foundations in the United States, of professional salaries, and of pension systems

THE League of Nations sets a high value on the dissemination among the children and youth of a knowledge of its aims and achievements The question how this may best be accomplished has been investigated during the past eighteen months by a joint committee representative of English and Welsh education authorities and teachers' professional associations, and the conclusions arrived at as a result of its labours are now published in a pamphlet entitled "Education and the League of Nations" The committee's investigations embraced work done in elementary and secondary schools and in training colleges and university training departments It is in the elementary schools that progress has been most marked In secondary schools there is a disposition to look askance at instruction in the principles and activities of the League as 'propaganda', and to mark time pending adaptation of examination syllabuses by the various school examination authorities to the League's educational policy The teacher training institutions do not seem to have made hitherto an adequate response to Lord Eustace Percy's appeal to the conference of local education authorities in June 1927, when he pointed out that it is above all the students at these institutions for whom opportunities must be provided for acquiring a sound knowledge and a balanced view of the origin and work of the League In its recommendations the joint committee has shown how this ideal may be translated into practice It deals also with such matters as school celebrations, visits to Geneva, interchange of correspondence, school journeys, and the interchange of schoolboys and girls If the minds of the rising generation are to develop the attitude postulated by the Kellogg Pact, it is essential that measures such as those recommended should be adopted, and not only in Great Britain but also among other, including less peace loving, peoples Copies of the pamphlet can be obtained (price 3*d* each) from the office of the League of Nations Union, 15 Grosvenor Crescent, London, S W 1

Historic Natural Events

Jan 1, 1926 Rhine Floods—The river began to rise rapidly on Dec 27, and by Jan 1 stood 32 feet above normal low water at Cologne, the highest level of the Rhine on record Three quarters of the town was under water, which stood 13 feet above the river banks Great damage was done by the Rhine, Scheldt, and Maas in Holland, dykes burst, and wide areas of low ground were flooded The floods were caused by heavy rain on the hills coinciding with high winter temperature and the melting of the snows

Jan 6-7, 1889 Rime—After two days of frost and dense fog in Norfolk, the wind changed to south west, and an unusually thick deposit of ice-needles, up to two inches in length, was formed on the windward sides of exposed objects Many isolated deciduous trees, especially birch, oak, elm, and poplar, were badly damaged, while nearly all overhead telephone and telegraph wires were broken down

Jan 6-7, 1839 Great Storm—On the night of Jan 6-7, western and northern Ireland, northern England, and southern Scotland were visited by an exceedingly violent gale from the south west, probably the worst since that of 1703 Many thousands of trees were uprooted in Ireland houses were unroofed, chimney stacks and walls blown down Many vessels were wrecked and there was great loss of life Menai Suspension Bridge was damaged

Jan 6-7, 1928 Thames Flood—The predicted height of the high tide at London Bridge on the early morning of Jan 7, that is, the height to which the water would rise if the meteorological conditions were normal, was 21 feet above Admiralty datum This is not especially high, for the predicted height sometimes reaches 25 feet The water actually rose nearly six feet above the predicted height, making the highest known level of the Thames in London, and flowed over or through the embankments at several points in the City, Southwark, Westminster, and westward to Hammersmith The low lying riverside districts are below the level of spring tides, and were deeply flooded, while fourteen people, most of whom were sleeping in basements, were drowned

The abnormal rise was due to a 'storm surge' in the southern North Sea On Jan 6 a deep barometric depression travelled rapidly across Scotland in an east south east direction, and in its rear a gale blew from north west and north over the North Sea during the evening, driving a storm wave southwards At 3 P M on Jan 6 the level was 1 6 feet above the normal tide at Dunbar Travelling along the east coast the wave grew in height and reached Southend at 11 P M, raising the level 5 feet Opposite the Thames estuary it divided into three parts, only a small part passed through the narrow Straits of Dover, raising the level about 3 feet, another part travelled north eastwards along the coast of Holland, and the remainder entered the Thames estuary, reaching London at 1 A M on Jan 7 An auxiliary factor in the London flood may have been the high level of the Thames itself, due to heavy rain and melting snow On Jan 7 the flow at Teddington Weir was 9500 million gallons a day, more than double the flow when the river is 'bank high' This river water would, however, be rapidly distributed in the widening estuary, and probably did not contribute more than a few inches to the height of the tide at London Bridge

Jan 7, 1558 'Calais' Storm—It is recorded by Holinshed that at the taking of Calais "began a marvellous sore and rigorous tempest, continuing the space of four or five days together" A severe thunderstorm beat down houses and churches

Jan 7, 1831 Luminosity —Owing to the presence of a kind of luminous mist, print could be read at midnight in Italy and Germany The abnormally light nights continued for a considerable period

Jan 8, 1924 Cyclonic Wave —A small but deep barometric depression passed from Ireland across France It was accompanied by a cyclonic wave which struck the coast of Brittany, causing the sea to rise 3 feet above the level of the highest spring tides, and inundating the coast

Jan 9, 1857 Californian Earthquake —An earthquake, preceded by strong shocks, was felt in southern California, from Sacramento to Fort Yuma, a distance of nearly 600 miles It was most severe at Fort Tejon, in the neighbourhood of which a fissure 40 miles long was formed A remarkable feature of the earthquake was its effect on the rivers of the district The water of the Mokelumne River was thrown on its banks so as to leave the bed bare in one place, while the stream of the Kern River was reversed

Jan 9, 1896 High Pressure over Scotland —During the second week of January, an anticyclone moved westward from the continent of Europe over the British Isles, where it combined with another anticyclone lying off our north west coasts, and increased suddenly in intensity At 8 A M on Jan 9 the barometer exceeded 31 inches (1050 millibars) over the whole of Scotland, the first appearance of that isobar on our weather charts The highest reading, corrected for gravity, was 31 139 inches (1054 5 mb) at 9 A M at Ochtertyre, Perthshire After Jan 9 the whole system moved away south westwards, and on Jan 10 the highest reading was just below 31 inches A remarkable return of high pressure occurred at the end of the month, when the corrected barometer rose to 30 975 inches (1048 9 mb) at Valentia, Ireland A peculiarity of both anticyclones was the mild weather associated with them In the British Isles high pressure in winter is generally associated with frost and fog, but on both occasions in January 1896 temperature was almost everywhere above the freezing point

Jan 10, 1608 Severe Winter —The winter of 1607–8 was probably the most severe on record in western Europe, and was long remembered as "the great winter" In England the cold continued from Dec 5 to Feb 14, but on the continent of Europe it continued until the middle of March On Jan 10, in a church in Paris, the wine froze in the chalice All the great rivers of western Europe were frozen, fires were lit on the Thames, and the Zuider Zee was crossed from Harlingen to Amsterdam Many human beings, cattle, and young trees were killed The break up of the ice was followed by great floods

Jan 10–15, 1820 Great Cold —A short period of very intense cold occurred from England to Italy Arago remarks that on Jan 10 a great number of mulberry trees split along their whole length, mostly trees from ten to thirty years old The openings remained until the end of the frost, after which they healed up and the trees survived An observer at Tunbridge Wells recorded that on Jan 15 the thermometer fell to −10° F, "the lowest by fourteen degrees that I ever remember it" The details of this thermometer and its exposure are not known, so that this reading cannot be compared with modern 'records'

Jan 11, 1900 Haloes and Mock Suns —Brilliant optical phenomena were visible over the greater part of south east England during the morning The common halo of 22° and the rarer halo of 46° were both visible and brilliantly coloured Above both haloes were arcs of contact, and a mock sun appeared to the right of the true sun on the 22° halo Some observers also saw a second mock sun to the left of the true sun

Societies and Academies

LONDON

Geological Society, Dec 18 —Frederick Walker The geology of the Shiant Isles The Shiant Isles form a small uninhabited archipelago in the North Minch, some five miles east of the Park district of Lewis The group is made up almost entirely of crinanite sills separated by relatively thin argillaceous strata which have undergone considerable contact-alteration, but the fossil content of which (ammonites, belemnites, and one species of *Inoceramus*) assigns them to a low position in the Upper Lias The two largest islands are each over a mile in length, and are joined by a shingle beach A third large island lies about a mile to the east, and is also to a great extent made up of a single thick sill of crinanite East of this island, however, the crinanite passes gradually into syenite, towards the centre of the sill, the thickness of the alkaline rock being at least 60 feet The age of the igneous activity is almost certainly Tertiary, and is probably the same as that of the Trotternish sills in Skye Although glacial striæ are not seen on the islands, their general aspect indicates a flow of ice from south to north during the Glacial Period

DUBLIN

Royal Irish Academy, Dec 9 —Gertrude Connolly The vegetation of southern Connemara The paper dealt with the vegetation of a large area lying west of Galway between the sea and the mountains—a vast tract of almost unbroken bog This area had not previously been examined botanically save along its margins Rainfall and humidity are very high, and in consequence the bogland is perennially extremely wet and difficult to explore The vegetation proved to be limited in number of species, and alternated mainly between those of drier and wetter bog

LEEDS.

Philosophical and Literary Society, Dec 10 —G W Brindley (1) On the dielectric constants of helium and argon The dielectric constants of these gases are calculated from the charge distributions obtained by Hartree, using an expression due to Pauling and others for the dielectric constant of an electron in a central field of charge Z^1e, Z^1 being chosen so that r^4 is the same for the hydrogen like distribution as for the Hartree charge distribution The calculated value of $(K-1)$ for helium agrees well with the experimental value, but the calculated value for argon is not good —(2) Note on the accuracy of constants in an optical dispersion formula The accuracy is considerably less than the accuracy of the experimental values of the refractive index In the case of methane, if $(\mu-1)$ is assumed accurate to 1 part in 50,000, the constants in the formula $(\mu-1)=C/(p^2-n^2)$ can only be accurate to about 1 per cent, owing to the form of the dispersion curve and the limited range of experimental data —(3) Note on distribution of charge with carbon atom (2) A continuation of a previous paper, pointing out that some new experimental measurements of the X ray scattering factor F are in good agreement with the theoretical value given in Part 1 —R Whiddington Note on the electron gun Experiments are described in which the electron beam from a gun is used in a cathode ray oscillograph and is found to possess a velocity much less than that calculated from the applied potential A curious shortening of the beam under certain conditions was also observed —J E Roberts and R Whiddington Note on inelastic electron

collisions in oxygen at low pressures Experiments are described in which electrons of about 100 volts velocity traverse oxygen gas at low pressure Quantum losses are observed and certain interpretations suggested —**A E Battye** and **H M Dawson** The nature of the reaction between phorone and iodine and the influence of the acidity of the aqueous medium on the reaction velocity The rate at which iodine disappears from the reaction mixture is determined by the velocity of the keto→enol transformation of the phorone The variation of the speed of the reaction in buffer solutions ranging from *p*H 3 to *p*H 9 shows that the major catalytic effects are due to the joint action of the hydrogen and hydroxyl ions The graph of the velocity against *p*H gives a catenary curve —**J Grainger** (1) The appearance of bean mozaic in England A short descriptive note on an infection in dwarf kidney beans at Weetwood, Leeds The symptoms of the malady are identical with those of bean mozaic described in America by Reddish and Stewart, Fajardo and others —(2) An attempt to cultivate the virus of tobacco mozaic *in vitro* Two experiments on the cultivation of the virus of tobacco mozaic *in vitro* are described One followed the method of Olitsky, and in the other a chloroplast suspension was employed Neither showed an increase in virus concentration during cultivation —**W H Pearsall** and **Alice Wright** The proportions of soluble and insoluble nitrogenous materials in fresh and dried plant tissues An examination has been made of the effect of drying leaves by the method of Link and Tottingham, upon the distribution of protein and non protein nitrogen The amount of non protein nitrogen extracted by 60 per cent alcohol is only slightly increased (1 5 2 0 per cent of total) by this method of drying The variations in the ratio of protein nitrogen to soluble nitrogen in dried leaves follow those in fresh leaves, but are proportionately lower In leaves having a higher water content there is no increase in the relative amount of hydrolysis on drying —**T M Naylor** and **A G Abel** An analysis of the link gear of an old beam engine A short illustrated description of the link gear of an old beam engine constructed by Boulton and Watt in 1792 and dismantled in 1888

LENINGRAD

Academy of Sciences (*Comptes rendus*, No 18) —**N N Nasonov** Contribution to the freshwater fauna of *Turbellaria rhabdocœlida* of Japan Fourteen species have been found on the island Chondo, several of them new to science One of the latter, *Macrostomum saifunicum*, is very near to the American *M sensitivum* —**K K Flerov** Some new data on *Capreolus* of eastern Asia Supplementary distributional data are given (see author's paper in *C R*, p 479, 1928), and descriptions of young animals of all species are presented —**M Galadzhiev** and **E Malm** The influence of some physico chemical factors on marine water Protozoa Studies on the influence of oxygen, hydrogen, and carbon dioxide in the water on marine Protozoa indicate that the effects may be very different even when the *p*H value is the same The main physiological factor proved to be the carbonic acid, towards which there is a specific reaction, for example, the Protozoa of the family *Tintinnoidea* are killed within 40 seconds in sea water saturated with carbon dioxide, while *Metopus sigmoides* can survive up to 9 days —**A B Verigo** An apparatus for the determination of the electrostatic capacity of electroscopes An apparatus is described which can be fitted on to the lid of an electroscope and permits of determining its capacity within 1 2 per cent —**A B Verigo** A rotary apparatus for increasing electric tension The apparatus described increases the tension up to five times

ROME

Royal National Academy of the Lincei Communications received during the vacation —**G Abetti** and **B Nováková** Structure of the line $H\alpha$ and period of rotation of the solar chromosphere A note on the dissymmetry of the line $H\alpha$ at the sun's border, as determined by spectrograms obtained at Arcetri, was published in 1926 A large number of measurements made in 1927 and 1928 give the result $H\alpha_3 - H\alpha_2 = -0\ 059 \pm 0\ 002$A, the centre of the dark component $H\alpha_3$ being hence displaced with respect to $H\alpha_2$, together with the emission components, by 0 059 A A series of spectrograms comparing opposite edges of the sun at various latitudes shows that the velocity of the hydrogen layer giving rise to the line $H\alpha_3$ is greater than that corresponding with $H\alpha_2$, that of the inverting stratum lying between the two The equatorial acceleration is sensibly the same for the three layers The dissymmetry appears to be greater in the east than in the west —**D Mercogliano** The quadratic complexes containing the congruence of the axes of a cubic hump and the conditions for two binary cubics having two common roots —**E Persico** and **F Scandone** The Hall effect with extended electrodes (1) —**M Merola** *R Scuti* A series of 85 photometric observations on this variable, made at Capodimonte between Aug 10, 1927, and Dec 6, 1928, indicate two maxima and four minima, and confirm the irregularity of the period and of the light curve, in accordance with the observations of Jacchia, Spears, Peltier, Carr, and Ford, and with the discussions of Sawyer and of Campbell —**F de Carli** Viscosity isotherms of binary mixtures (4) The system, benzaldehyde sulphur monochloride Thermal analysis of this system being impossible, since all the mixtures give, on cooling, viscous masses with scarcely appreciable velocities of crystallisation, use has been made of the viscosity The maximum divergence of the observed from the calculated viscosities occurs with mixtures containing 60 per cent of the aldehyde, the formation of the compound $2C_6H_5CHO, S_2Cl_2$ being thus indicated —**A Ferrari** and **A Inganni** The importance of the crystalline form in the formation of solid solutions (6) Thermal and X ray analysis of the anhydrous systems $CaCl_2 - CoCl_2$, $CaCl_2 - FeCl_2$, $CaCl_2 - MnCl_2$, and $CaCl_2 - CdCl_2$ Cobaltous and ferrous chlorides give eutectics with calcium chloride at 614° and 592°, the molecular proportions of the calcium salt being 54 3 and 44 5 per cent respectively Manganese and cadmium chlorides give mixed crystals with calcium chloride in all proportions, and these crystals, even with small proportions of one of the components, decompose into their constituents at about 475° and 414° respectively The behaviour of these systems points to a difference between the structure of calcium chloride and those of the rhombohedric chlorides of cobalt, iron, magnesium, manganese, and cadmium, since none of the systems shows the complete miscibility devoid of maximum and minimum solidification temperatures characteristic of isomorphous mixtures Assuming Goldschmidt's values, the radii of the ions are Co^{++} 0 82 A, Mg^{++} 0 78 A, Fe^{++} 0 83 A, Mn^{++} 0 91 A, Cd^{++} 1·03 A, Ca^{++} 1 06 A —**G Piccardi** Spectrographic detection of bismuth in the ashes of animal organisms If certain modifications are made in the circuit, the detection of very small amounts of bismuth is possible by means of lines in the ultra violet region of the spark spectrum, especially the line λ3067, which is observable with solutions containing only 0 001 per

cent of the metal —**G Scagliarini** and **P Pratesi** The colour reaction between sodium nitroprusside and creatinine Two possible formulæ are suggested for the ruby coloured substance formed, according to Weyl's test, by the action of sodium nitroprusside on creatinine in alkaline solution —**G Scagliarini** and **G Tartarini** Additive compounds of halides of bivalent metals with organic bases (7) The following hexamethylenetetramine compounds are described $2MgCl_2, 16H_2O, 5C_6H_{12}N_4$, $2MgI_2, 16H_2O, 5C_6H_{12}N_4$, $2MgBr_2, 16H_2O, 5C_6H_{12}N_4$, $2CaCl_2, 8H_2O, 5C_6H_{12}N_4$ —**Giambattista Dal Piaz** Geological notes on the region of the Aurine Alps and of the Giant Vedrettes (Upper Adige) —**A Palombi** The biological cycle of *Diphterostomum brusinæ* Stossich (Digenetic trematode fam Zoogonidæ Odhner) —**M Tirelli** Opening of Malpighian tubes in the meso intestine —**G Mezzadroli** and **E Vareton** Action of Wood's light on the germination of seeds and on the growth of plants Experiments on barley, beans, peas, and maize show that Wood's light exerts a favourable influence on the germination of seeds and on the growth of plants when applied for 15 minutes to some hours per day The action is especially favourable during the early stages of development, the plants being increased in number, vigour, and height —**G Mezzadroli** and **E Vareton** Comparison between the actions exerted by ultra short electromagnetic waves (λ2 3 mm) and by the Lakhovsky oscillating circuit on the germination of seeds and the growth of plants The favourable influence of electromagnetic waves on seeds and plants is similar to, but more marked and more constant than, that of the Lakhovsky circuit and is a function of the intensity of the waves them selves —**P Pasquini** and **G Meldolesi** Investigations on radio sensitiveness in the development of the eggs of amphibia (1) Differential radio susceptibility of the various embryonic stages (Anurans) —**M Curzi** A new and serious disease of maize During last June certain maize was attacked, with loss of about 80 per cent of the plants, by a malady which resulted in necrosis at the base of the stalk The plants affected fell to the ground and there continued to grow without any sign of withering, communications between the aerial and subterranean organs remaining uninterrupted The disease is due to a mould, probably communicated from the previous year's crop of beet —**Constantino Gorini** Acido proteolytic enzymes of tanning

SYDNEY

Royal Society of New South Wales, Nov 6 —**A R Penfold** and **J L Simonsen** Note on the leaf oil from *Dacrydium Franklinii* Hooker The chemical composition of the terpene fraction as previously revealed was confirmed, but the principal terpene for which the name dacrydene was proposed has now been shown to consist of Δ ⁴carene and beta pinene The former is a new bicyclic terpene first isolated by Dr Simonsen from Indian pine oil The solid diterpene, phyllocladene, was also isolated from this oil —**A R Penfold** and **F R Morison** The essential oils *Melaleuca decora* (Salisbury) Druce and *M Nodosa* var *Tenuifolia* (de Candolle) from the Port Jackson District (1) The principal constituents of oil from the former are *d* α pinene (50 60 per cent) and sesquiterpenes (25 30 per cent), with small quantities of α terpineol, dipentene, and sesquiterpene alcohol The oil from the later yields cineol (40 55 per cent), α pinene, dipentene, α terpineol, sesquiterpene, etc Both these species of paper bark tea tree occur in extensive areas close to Sydney, but the rapid advancement of settlement foreshadows their extermination at an early date

Official Publications Received

BRITISH

Canada Department of Mines Mines Branch Core Drilling Bituminous Sands of Northern Alberta By S C Ells (No 710 1) Pp 26 (Ottawa F A Acland)

Southern Rhodesia. Report of the Education Commission Pp ii+187 (Salisbury)

Report on the Somaliland Agricultural and Geological Department for the Years 1927 and 1928 Pp 48 (London The Crown Agents for the Colonies) 2s

Department of Scientific and Industrial Research Report of the Building Research Board with the Report of the Director of Building Research for the Year 1928 Pp viii+141+13 plates (London H M Stationery Office) 3s 6d net

Tide Tables for the Eastern Coasts of Canada for the Year 1930 Including the River and Gulf of St Lawrence the Atlantic Coast the Bay of Fundy, Northumberland and Cabot Straits, and Information on Currents In addition Tide Tables for New York and Boston U S A Issued by the Tidal and Current Survey Division of the Hydrographic Service, in the Department of Marine and Fisheries of the Dominion of Canada. (Thirty fourth year of Issue) Pp 90 (Ottawa F A Acland)

Canada Department of Mines Mines Branch Summary Report 1928 Part A (No 2202) Pp 210A+4 plates Summary Report 1928, Part B (No 2206) Pp 131B+5 plates Memoir 158 Britannia Beach Map area, British Columbia By H T James (No 2193) Pp ii+139+4 plates 25 cents (Ottawa F A Acland)

The Scottish Forestry Journal being the Transactions of the Royal Scottish Arboricultural Society Vol 43 Part 2 October Pp xii+81 168+87 46 (Edinburgh) 7s 6d

Ministry of Agriculture and Fisheries Marketing Leaflet No 15 The Commercial Pig Interim Report by the Pig Industry Council Pp 12 (London Ministry of Agriculture and Fisheries)

Proceedings of the Society for Psychical Research Part 113 Vol 39 December Pp 193 246 (London Francis Edwards Ltd) 1s 6d

FOREIGN

Scientific Papers of the Institute of Physical and Chemical Research No 217 On the Difference of Behaviours of Different Parts of Three Part Spark in Igniting Combustible Gas Mixture By Torahiko Terada Kiyohiko Yumoto and Ryozo Yamamoto Pp 137 148+plate 15 (Tokyo Iwanami Shoten)

Contributions from the Dudley Herbarium of Stanford University Vol 1 No 3 A New Genus of the Saxifrage Family by Leroy Abrams and Bruno Bacigalupi Two New Howellias from Oregon, by Elmer I Applegate Four New Plants from San Diego County California by Ira L Wiggins Pp 89 109+plates 9 (Stanford University, Calif Stanford University Press) 60 cents

Stanford University Publications University Series Biological Sciences Vol 5 No 3 The Principles of Systematic Entomology By Prof Gordon Floyd Ferris Pp 169 2 dollars Vol 6 No 1 A Contribution toward a Monograph of the Adelginae (Phylloxeridae) of North America By Dr P N Annand Pp 146 2 dollars (Stanford University Calif Stanford University Press)

Department of the Interior U S Geological Survey Bulletin 800 Geology and Mineral Deposits of Southeastern Alaska By A F Buddington and Theodore Chapin Pp x+398+22 plates 85 cents Bulletin 804 Geology and Coal and Oil Resources of the Hanna and Carbon Basins Carbon County Wyoming By C E Dobbin C F Bowen and H W Hoots Pp vi+88+27 plates 60 cents Bulletin 812 A The Forsyth Coal Field Rosebud Treasure and Big Horn Counties Montana. By C E Dobbin (Contributions to Economic Geology 1929 Part 2) Pp v+55+10 plates 20 cents (Washington, D C Government Printing Office)

Department of the Interior U S Geological Survey Water Supply Paper 597 C Problems of the Soft Water Supply of the Dakota Sandstone with Special Reference to the Conditions at Canton South Dakota By Oscar E Meinzer (Contributions to the Hydrology of the United States 1928) Pp ii+147 170+plate 90 Water Supply Paper 597 E Surface Water Supply of the Sacramento River Basin, California 1895-1927 By H D McGlashan (Contributions to the Hydrology of the United States 1928) Pp vi+189 250 10 cents Water Supply Paper 611 Surface Water Supply of the United States 1925 Part 11 Pacific Slope Basins in California Pp viii+383 50 cents Water Supply Paper 612 Surface Water Supply of the United States 1925 Part 12 North Pacific Slope Drainage Basins A Pacific Basins in Washington and Upper Columbia River Basin Pp v+160 25 cents (Washington D C Government Printing Office)

Diary of Societies

FRIDAY, JANUARY 3

PHYSICAL SOCIETY (at Imperial College of Science), at 5

INSTITUTION OF MECHANICAL ENGINEERS, at 6 —Eng Vice Admiral R W Skelton Progress in Marine Engineering (Thomas Lowe Gray Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7 —J G Wellings and C G Mayo Instrument Transformers

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting) at 7

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7 30 —F T Wood Speedy Draughtsmanship

SATURDAY JANUARY 4

ROYAL INSTITUTION OF GREAT BRITAIN (at Institution of Electrical Engineers), at 3 —S R K Glanville How Things were done in Ancient Egypt (Christmas Lectures) (4) Boats and Furniture

MONDAY, JANUARY 6.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 3.30.—Major C K. Cochran Patrick Places seen from the Air (Christmas Lectures) (1).
INSTITUTION OF AUTOMOBILE ENGINEERS (Western Centre) (at Merchant Venturers Technical College, Bristol), at 7 —W L Morgan Organisation of Public Service Motor Vehicle Repairs and Maintenance Systems
BRADFORD TEXTILE SOCIETY (at Midland Hotel, Bradford), at 7 30 —W H. Ambler Single Dry Spun Yarns
ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8 —Dr R. Unwin Regional Planning, with Special Reference to Greater London.
SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8 —C J J Fox The Micelle Chemistry of Cellulose —J A Pickard Metafiltration.
TWICKENHAM LITERARY AND SCIENTIFIC SOCIETY (at Free Library, Twickenham), at 8 —Dr E. H. Rayner Power Transmission at High Voltages

TUESDAY, JANUARY 7

ROYAL INSTITUTION OF GREAT BRITAIN (at Institution of Electrical Engineers), at 3 —S. R. K Glanville How Things were done in Ancient Egypt (Christmas Lectures) (5) The Workshops
BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (jointly with Nursery School Association) (at University College), at 5 30 —Principles and Practice in Nursery School Education —Mrs S. Isaacs What the Nursery School can do for the Young Child —Miss Lillian de Lissa Nursery School Aims and Problems
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7 —L. Richmond The Modern Tendency in Art
INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates Meeting) (at Broad gate Café, Coventry), at 7 15 —J R. Harnott The Rigid Six wheeled Vehicle
INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts) at 7 45 —T W Cooper Roller Bearings
TELEVISION SOCIETY (at Engineers Club, Coventry Street), at 8 —W S Newton Photographic Problems of Picture Telegraphy

WEDNESDAY, JANUARY 8

GEOLOGICAL SOCIETY OF LONDON at 5 30 —Dr Stanley Smith On some Valentian Corals from Shropshire and Montgomeryshire with a Note on a New Stromatoporoid —Dr Stanley Smith The Carboniferous Inliers at Codrington and Wick (Gloucestershire).
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at 20 Hart Street, W C 1), at 7 —C A Masterman Combustion, Wind and Flue Equipment.
ELECTROPLATERS AND DEPOSITORS TECHNICAL SOCIETY – E. Downs Electrolytic Gold Refining

THURSDAY, JANUARY 9

ROYAL INSTITUTION OF GREAT BRITAIN (at Institution of Electrical Engineers), at 3 —S R K Glanville How Things were done in Ancient Egypt (Christmas Lectures) (6) Hieroglyphs
LINNEAN SOCIETY OF LONDON, at 5 —W H Thorpe Further Notes on Biological Races in *Hyponomeuta padella* (Linn).—J T Cunningham The Origin of Adaptations
INSTITUTION OF ELECTRICAL ENGINEERS at 6 —T W Ross and H G Bell Recent Developments in the Protection of Three Phase Transmission Lines and Feeders.
ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30 —R. McKinnon Wood The New American Wind Tunnel
INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group—Informal Meeting), at 7 —F W Sharp Dyebro —F R Newens A New Formula and Method for 3 colour Carbo
INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub Centre) (at University College Dundee) at 7 30 —G H Chalmers Lubrication
INSTITUTE OF METALS (London Local Section) (at 83 Pall Mall) at 7 30 —G Mortimer The Aluminium Industry
SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (at Bristol University), at 7 30 —F G Conyers Wood Distillation
OIL AND COLOUR CHEMISTS ASSOCIATION, at 7 30
INSTITUTE OF BREWING (North of England Section) (at Midland Hotel, Manchester) —Dr L H Lampitt The Historical Development of Work on Yeast.
INSTITUTE OF CHEMISTRY —Dr A M Bronte The Medical Witness
NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees Side Branch).—J W Hobson Locomotives for Industrial Purposes and their Maintenance
INSTITUTION OF THE RUBBER INDUSTRY (Birmingham and District Section) (at Grand Hotel, Birmingham).—H Standring Outstanding Features in the Progress of the Rubber Industry

FRIDAY, JANUARY 10

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 3 30 —H G Watkins By Canoe and Dog Sledge in Labrador (Christmas Lectures) (2)
ROYAL SOCIETY OF ARTS (Indian Section), at 4 30 —Sir Basil P Blackett The Economic Progress of India.
ROYAL ASTRONOMICAL SOCIETY, at 5 —E A. Kreiken The Frequency of Double Stars of Different Spectral Types and Absolute Magnitudes —J Jackson The Shortt Clocks of the Royal Observatory, Greenwich with Special Reference to the Effect of Variation in Arc —H Jones Deviations from Boyle's Law in Stellar Interiors.
MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College), at 6.
NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon Tyne), at 6 —L. C Burrill Design and Construction of the Rail-car carrying Steamship *Seatrain*
SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (at Engineers Club, Manchester), at 7 —Dr E K Rideal Some Aspects of Surface Chemistry and their Industrial Implications.
INSTITUTION OF ELECTRICAL ENGINEERS (North Western Centre) (at Free Trade Hall, Manchester), at 7 —Capt P P Eckersley Broadcasting by Electric Waves (Faraday Lecture).

OIL AND COLOUR CHEMISTS ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7 —Prof T P Hilditch Recent Research on Fats bearing upon the Drying of Oils in Paint and Varnish.
GEOLOGISTS ASSOCIATION (at University College), at 7 30 —J Pringle The Geology of Ramsey Island (Pem).—*Papers to be taken as read* —The Palæobotany of the Kent Coalfield, Dr R. Crookall and J Pringle, The Preparation of Thin Sections of Friable and Weathered Materials by Impregnation with Synthetic Resins, R. J Schaffer and P Hirst
JUNIOR INSTITUTION OF ENGINEERS, at 7 30 —H J N Riddle The Track Circuit in Railway Signalling
SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Burlington House), at 8 —J R Booer Autogenous Welding in Chemical Works
PHILOLOGICAL SOCIETY (at University College), at 8 —G G Loane Notes on N E D
SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Cardiff).—E. H Williams Graphitic Lubricants

PUBLIC LECTURE.

TUESDAY, JANUARY 7

PHILOSOPHICAL HALL, LEEDS at 6 —E G Boulenger Behind the Scenes of the Zoo Aquarium (Christmas Lecture).

CONFERENCES

JANUARY 3

MEDICAL OFFICERS OF SCHOOLS ASSOCIATION (at University College), at 2 30 —K D Young School Sanatoria
BRITISH ASSOCIATION FOR PHYSICAL TRAINING (at University College), at 5 30 —Dr D J Harris The Electrical Phenomena of Muscle

JANUARY 3 AND 4

SCIENCE MASTERS ASSOCIATION (at Imperial College of Science)
Friday, Jan 3, at 9 30 A M —W Corbridge Lecture Demonstration on Some Home Made Physical Apparatus
At 10 45 A M —Dr J C Munro Industrial Biology (Lecture)
At 12 —Prof Truscott and others Discussion on Openings for College Trained Men in the Mineral Industry
At 5 15 —Discussion with the Physical Society on Examinations in Practical Physics.
At 8 15 —Discussion on School Certificate Biology
Saturday Jan 4 —Visits to the National Physical Laboratory and the Government Laboratory

GEOGRAPHICAL ASSOCIATION (at London School of Economics)
Friday, Jan 3 at 10 A.M —Discussions —The Physical Basis of Geography in Independent Schools Opened by B B Dickinson —Geography and the Training of Teachers Opened by T Herdman
At 11 30 A.M —Col H L. Crosthwait Air Survey (Lantern Lecture)
At 2 30 —The Geography I was Taught, by Members of the Association
Saturday, Jan 4 at 10 30 A M – Sir E J Russell Agricultural Developments in South Africa (Lantern Lecture).
At 11 45 A M —Dr Vaughan Cornish National Parks.

JANUARY 6 AND 7

MATHEMATICAL ASSOCIATION (Annual Meeting) (at London Day Training College)
Monday, Jan 6 at 4 —R I Gimson and others Discussion on Arithmetic of Citizenship
At 5 30 —Prof S Chapman The Use of Spherical Harmonic Functions in Mathematical Physics
Tuesday Jan. 7 at 10 A M —G W Spriggs and others Discussion on Problems of Individual Education with Special Reference to Work in Mathematics
At 11 45 A M —Prof W M Roberts Gunnery and some of its Mathematical Problems (Lecture),
At 2 30 —Dr W F Sheppard Mathematics for Study of Frequency Statistics
At 3 45 —Miss Hilda P Hudson and others Discussion on The Mathematician in Ordinary Intercourse

JANUARY 7

NATIONAL COUNCIL FOR MENTAL HYGIENE (at University College) at 3 —Discussion Preventable Mental and Physical Strains of School Life.

EXHIBITION

JANUARY 7, 8, AND 9

ANNUAL EXHIBITION OF THE PHYSICAL SOCIETY AND THE OPTICAL SOCIETY (at Imperial College of Science) from 3 to 6, and from 7 to 10
Jan 7, at 8.—Lord Rayleigh Iridescent Colours in Nature from the Standpoint of Physical Optics (Lecture)
Jan. 8 —S. G Brown Gyro Compasses for Gun Fire Control (Lecture),
Jan. 9 —Sir Ambrose Fleming Television, Present and Future (Lecture)

Editorial and Publishing Offices
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SATURDAY, JANUARY 11, 1930

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No 3141, Vol 125]

School Certificate Biology

THERE are indications that, in the not far distant future, there may be removed from our courses of education the reproach that in England alone of practically all civilised countries is it possible for a student at the age of eighteen or nineteen to leave school destitute of any teaching in the fundamental processes of life Biology as a subject in the School Certificate Examinations has received attention at the Headmasters' Conference, a report containing suggestions for a syllabus has lately been published by a committee of the British Association, and a committee appointed by British zoologists "to consider the position of animal biology in the school curriculum and matters relating thereto" has also reported upon the subject It is, too, a hopeful sign that nearly all examining bodies granting school certificates now include biology among the examination subjects, and further, that the number of candidates offering it, though still a very small percentage of the whole, shows a steady increase

It is clear that in formulating a syllabus and in determining the scope of this examination, the opinion of those engaged in teaching biology at schools should carry great weight They are familiar with the conditions prevailing in the schools, and, far better than professors and lecturers at the universities, can judge not only what is feasible, but also what is within the mental reach of pupils at the age of sixteen or thereabouts The Science Masters' Association was thus well advised in arranging a discussion on school certificate biology during its recent conference at the Imperial College of Science, and in endeavouring to secure a consensus of opinion regarding the purpose of such biology and the character of the examination itself The propositions laid down in order to focus discussion were as follows

(*a*) Biology should be a subject in which it is possible to obtain "credits", and must not be regarded as a "soft option", but nevertheless it is obvious that the same number of hours will never be allotted to it as to mathematics, languages, etc

(*b*) School Certificate Biology is intended to be for general education purposes, and not as a preparation for specialised Higher Certificate work

(*c*) The examining bodies should keep their detailed syllabuses as short and general as possible

(*d*) A knowledge of Chemical and Physical processes is not to be demanded except in so far as they are necessary for an elementary understanding of definite biological principles

(*e*) There should be no practical examination, demonstration lectures taking the place of individual practical work

(*f*) A syllabus should include

1 The fundamental principles of plant physiology and propagation, but without any unnecessary anatomical details
2 The elements of human physiology and dependence of all animal life on the green plant for its source of energy
3 The carbon and nitrogen cycle, and the part played by bacteria and fungi in nature
4 Amœba, Hydra, and the Frog (These should be the only actual animal types mentioned)
5 Structure of a regular flower to show pollination and fertilisation
6 An elementary knowledge of, at least, the evidences of Evolution, and the principles of Heredity

(*g*) Definite "Field Work" is impossible for boys at this stage during school hours

The suggested syllabus is commendably brief, and appears to include all the essentials, though teachers will probably allude to other than the three animals specified in (*f*) 4, and to some of the more striking irregular flowers when dealing with pollination, and will find occasional expansion of this bare minimum desirable There is clearly no intention to restrict the teacher rigidly to the scheduled items

The second of the above propositions (*b*) needs strong emphasis In the past there has been too great a tendency to teach elementary science on lines suited to students destined later to specialise in science, and to disregard the fact that an enormous majority of the pupils at this stage are not so destined It is not unnatural for a teacher, especially for a young one who has but recently completed an advanced course at the university, to teach on the lines along which he himself, a specialist, has been taught But the temptation must be resisted Prior to and up to the school certificate examination, all the science teaching should be solely for purposes of general education and culture It should pave the way for the future citizen to take an intelligent interest in the progress of modern thought, and in social legislation, hygiene, and the general welfare of mankind, and should render possible, nay probable, a fuller, happier life, a better use of the environment, and a keener appreciation of its beauty and mystery

These considerations, coupled with the reference to chemical and physical processes in the fourth proposition (*d*), raise the question—Is the present policy of allowing chemistry, physics, or biology to be offered as separate subjects in the school certificate examinations wise and educationally sound? Their very separation savours of specialisation A candidate offering biology must have had some instruction both in chemistry and in physics, but the converse is not true—greatly to the loss of the candidates concerned

Now in other school certificate subjects candidates are really examined on work that has been spread over several years, dating back in some cases to the very commencement of their education, though perhaps pressure of the examination 'screw' has been applied only for a year or two preceding the examination The above suggested syllabus, however, and some of those prescribed by examining bodies for other scientific subjects, can be covered satisfactorily in three or four terms, with a time table allotment of about three hours per week It would assuredly be preferable that the period during which the science has been studied should be more nearly commensurate with that pertaining to other subjects of the examination This end could be achieved if in the school certificate the only science allowed were 'general', and if the 'general science' were based on biology, broadly conceived as the science of life for all

The Science Masters Association's syllabus affords abundant opportunity for digressions into the realms of chemistry and nearly all branches of physics Such digressions might extend over several weeks, or even a whole term, and would certainly provide ample material for individual experimental work Even with the short syllabus suggested, the biology master worth his salt is bound to refer in teaching to a large number of topics that already find a place in the elementary text books of chemistry and physics, for example, the properties of air and of water, oxidation, conservation of energy, and so on Thus the digressions would have as their objective the elucidation of many of the properties of living matter, and the whole course would gain in coherence and in interest Such a syllabus might well serve as the nucleus of a two year or three year course, according to the number of hours per week assigned in general science for the school certificate examination The standard, measured by the amount of ground covered, should be low, but a high degree of accuracy should be demanded It is only thus that sure foundations are laid

To carry out such a reform in the teaching will require careful co ordination of the work, and loyal co operation among the teachers in each school Such co ordinated schemes of science teaching are, and have been for some years, in operation in nearly all the countries of western Europe The like should surely not be beyond the organising ability of the schools and universities of England

Statistical Method in the Social Sciences

The Statistical Method in Economics and Political Science a Treatise on the Quantitative and Institutional Approach to Social and Industrial Problems By Prof P Sargant Florence (International Library of Psychology, Philosophy and Scientific Method) Pp xxiv + 521 (London Kegan Paul and Co , Ltd , New York Harcourt, Brace and Co , 1929) 25s net

UNTIL just recently, statistics have not been regarded as a very essential part of economics or political science, or indeed of any of the social sciences, but have been looked upon as rather dull and drab accessories, to be relegated to the end of the book as mere appendices There is scarcely a single table or diagram in any of the older classics, and although measurability, in Lord Kelvin's well known dictum, was supposed to be the hall mark of any true science, it was rather furtively hoped that economics, at all events, if not the other members of the social group, could somehow be shuffled through the portals into the world of science without possessing any great store of measurable data

There has been some improvement, during the last few years, in the introduction and use of statistical method in economics, but Prof Sargant Florence is probably right in saying that attempts at the scientific study of mankind in the economic and political spheres have largely broken down owing to faulty liaison work between the non statistical and the statistical methods of approach "The mathematical statistician is out of touch with the expert in a special field, and the experts, whether economists, political scientists, or sociologists, generally fail to make use of statistical methods and busy themselves with repeating the same unverified hypotheses, or pitting one equally unverified hypothesis against another " The trail so brilliantly blazed by Jevons has not been adequately followed up, and though there has been considerable advance in the study and appreciation of statistics and a vast output of statistical studies and compilations bearing more or less directly on different fields of economics, little real fusion of economic theory with measured observations has been achieved There have been, it is true, some notable exceptions among the economists, such as H L Moore, Wesley Mitchell, Taussig, Cassel, Pigou, and Marshall, who have combined a profound knowledge of economic theory with sound statistical skill, but in the main, the argument holds that modern economics is still largely concerned with the elaboration or more or less plausible theories insufficiently supported by verifiable data

A further criticism which seems well justified—although it has always been easy enough to pile up criticism against the economist and all his ways, justifiable or not—is based on the attempts to separate the economic from the political, and to make two entirely distinct entities of economics and political science For purposes of specialised study this may be desirable, but despite the dictates of specialism, which may sometimes be followed too slavishly and fearfully, it cannot be too strongly insisted that the social sciences at all events should, so far as possible, be studied as one Certainly economics and political science cannot be separated for long, and this becomes more clearly apparent when their statistical foundations and structure are envisaged It is the supreme merit of Prof Sargant Florence, when planning his great work, that he has co ordinated and correlated in a wonderfully skilful manner, the highly complex data of economics and political science, and used the statistical approach for his purpose in such a way that the result is a triumph in homogeneity, a noble architectural pile, deeply impressing the observer with its massive strength, completeness, well balanced proportions, and unity

Various devices have been sought, but seldom found, for counteracting the evils of specialism in modern science, for providing a higher and more comprehensive viewpoint, for seeing a science or branch thereof in its remoter connexions, for co ordinating related parts Philosophy has sometimes been called upon to fulfil this important rôle , but that statistical method also could be used to serve the same end, though to a lesser degree, was an original and brilliant conception which Prof Florence has worked out with indefatigable perseverance, amazing skill, and comprehensive grasp of a vast field in economics and political science The expert statistician may not always agree with the author in certain details of technique, some of which he himself admits may be heretical , and truly, in such an elaborate technique, even though higher mathematics is eschewed, there are bound to be some controversial points for the hyper critical specialist , but for the general reader, for the general student of economics and political science, the work is invaluable as a veritable storehouse of the latest research in statistical method as applied to these particular social sciences It sums up the work of all the best authorities, but most of it is the author's own, is fresh, original, stimulating, and written in that lucid and charming style that

one has been led to expect from Prof Florence Its breadth and thoroughness are remarkable, for it is very much more than a mere text-book on statistical method It is also a comprehensive treatise on economic and political science so far as these are amenable to statistical treatment, and the extent of that amenableness is much greater than is commonly supposed, as may be gathered from the following brief summary of contents, taken from Chaps i and ii

The function of economics and political science is the discovery and study of fact in the indicative mood, free from moral implications, and from optative or imperative attitudes Scientific knowledge must first be obtained before it can be applied to produce the results desired for the good of mankind

In the pursuit of knowledge the primary function of statistics is to describe item facts summarily Such descriptions may substitute experience for unfounded or ill founded assumptions, and verify or refute economic or political theory, or suggest pertinent generalisations of their own for theory to interpret The statistical approach can be shown to be not inferior to deductive reasoning as mental discipline

The focus and scope of economics and political science are described, and a further subdivision of the complete field is suggested into (*a*) economics, (*b*) political science proper, (*c*) political economics, and (*d*) economic politics This method of sub dividing is perhaps open to criticism Economic, political, and institutional inter relations are next dealt with, thus completing Part I In Part II are described very fully the methods and technique of statistical measurement The principles of classification and orientation demanded by qualitative differences and complexities are given in Part III, together with the principles and pre cautions to be observed in representing qualities through quantitative index numbers This part includes a discussion of both statistical and non statistical methods of causal interpretation, such as isolation of factors, experiment, and introspection In Part IV we proceed to tackle the intricacies of economic theory, modified in certain important respects, especially in the direction of flexibility, in order to suit statistical requirements The statistical approach starts from item facts, but may use established theories as plausible working hypotheses Eventually, statistically tested theories or theoretically interpretable statistics may perhaps be found to rest upon a solid and exact physical or psycho physiological basis

In political science there is no body of accepted theory but merely some structural and functional analysis, and the statistician must build up his own theories empirically by the correlation of varieties of structure, procedure, and transactions, and by the correlation of varieties of objectively distinguishable procedures such as ruling, work-sharing, and manning

It will be seen that Prof Florence goes as deeply as is possible for a statistician to go in investigating the complex phenomena of mankind's behaviour in the economic and political spheres, even to the extent of finding a measure for the psycho-physiological (Why not psychological simply ?) factors of exchange, but since he has necessarily excluded all ethical and moral implications, as ruthlessly indeed as the American economist, General Walker, has done, and adhered faithfully to the indicative mood, the inquiry would seem to stop short at its most interesting and practically valuable stage

Presumably it is left for the social philosopher to expatiate in the optative mood, and the statesman in the imperative mood The former, with out-stretched arms and full of a burning zeal for the welfare of mankind, seeks persuasively to inculcate political wisdom wherever this is to be found, whilst the latter imperatively thunders forth his commands Both should be as well grounded in the statistical approach to economics and political science as Prof Florence, but is this possible ? Or is it too much to hope that Prof Florence himself will work out for us the ethical and moral implications, and supplement and co ordinate such of these implications as are already scattered about in some of his other books, for example, in "Economics and Uplift", continuing on a larger and more comprehensive scale the work already begun by Sir Wilfrid Ashley, Prof Cunningham, and one or two others ? This would be a real contribution to the clarification of politics, establishing it on a more scientific basis, and a contribution also to the true art of statesmanship which cannot possibly be considered apart from ethics and morals Prof Florence's book raises numerous other questions of the utmost importance, discussion of which is pre cluded by lack of space

Sterilisation as a Practical Eugenic Policy

Sterilisation for Human Betterment a Summary of Results of 6000 Operations in California, 1909–1929 By E S Gosney and Dr Paul Popenoe (A Publication of the Human Betterment Foundation) Pp xviii + 202 (New York The Macmillan Co, 1929) 8*s* 6*d* net

THIS little book is a storehouse of information on the efforts which have been made in the United States to improve the human stock by sterilising the feeble minded and the insane It appears that although *more Americano* laws have been passed in about twenty states of the Union

providing for the legal sterilisation of sexual perverts, and imbecile and insane patients in public institutions, these laws have been put into practical operation only in the State of California, so that in the book discussion is mainly concerned with the results obtained in that State

The justification for these attempts to aid Nature in eliminating the unfit is set forth in the introduction Amongst our unsentimental forefathers, no efforts were made to keep alive weakly and diseased children, and hence the race was propagated only from its most vigorous members, but nowadays, when unreflecting humanitarian sentiment is in fashion, all babies are kept alive so far as medical science can avail, and this science is paid for by levying tribute on the thrifty and self supporting The result is that this section of society limits its offspring, and future generations are likely to be recruited not from the fit but from the unfit

How drastically and efficiently natural selection operated amongst the young in England during the eighteenth century may be gathered from figures given by Miss Buer in her book, "Health, Wealth, and Population in the Early Days of the Industrial Revolution" In 1730, out of all babies born in London, 74 per cent died before they were five years of age, in 1750, 63 per cent died, in 1770 the percentage was 50, and it did not sink to 30 until 1833 The percentage was probably even higher in other parts of the country The help given by hospitals, and later by the State, to indigent mothers has all grown up in the last century, so that the argument that because we have maintained a vigorous, enterprising, fighting race in these islands for eight hundred years since the Norman Conquest, we shall continue to do so, is not one for which there is any sound basis

It is, however, not practical politics to suggest a return to the old plan of *laissez faire* How then shall the elimination of the unfit be promoted? The authors of this book suggest 'by legalised sterilisation' The method of sterilisation advocated is cutting the ducts (vasa deferentia in the male, and Fallopian tubes in the female) which convey the germ cells to the exterior The authors point out that more than six thousand operations of this sort have been already performed in California, and that only seven failures are recorded (three in males, four in females) The operation does not interfere with sexual desire or the performance of the sexual act The genital organs in man, as in Vertebrata generally, have two functions, namely. (1) to produce the germ cells, (2) to produce a hormone which diffuses through the system and maintains youth and vigour In a man the spermatozoa forms a minor part of the sexual discharge, the main portion of which is constituted by the prostatic secretion, and some authorities hold that this secretion when absorbed by the female has an invigorating effect on the constitution As to a woman, when it becomes necessary on account of tumours to remove the uterus, if a portion of one of the ovaries is preserved and sewn to the abdominal wall, this will prevent the premature onset of the menopause and maintain in the patient all the qualities of a young woman

But are insanity and mental defect hereditary? Some British authorities hold that in many cases they are not So far as insanity is concerned, however, there is general agreement, as our authors point out, that the condition known as 'dementia praecox' is the result of an inborn weakened constitution, and that it is a mere question of time when it will manifest itself in the life of the unfortunate individual who has inherited this constitution As to mental defect, the argument that it is sometimes not of hereditary origin, overlooks the consideration that all 'mutations', of which mental defect is one, must ultimately have been produced by some external cause, and there is nothing to show that an 'accidental' mental defective will not propagate mentally defective children In any event, even if a defective should produce healthy children, such a person would make the worst possible parent to carry out the duty of caring for and training the children, and it is a little too much to ask the State to allow a defective to go on having children on the chance of some of them being normal, if the State has to support them all

Our authors urge that sterilisation should not be regarded as a punishment but as a hygienic measure, that defectives confined in asylums might be allowed out on condition of their consenting to this operation But whilst we agree that this argument is good so far as it goes, a little reflection will show that it only touches the fringe of the problem The defectives most dangerous to society are those who are never confined in institutions at all! The high grade defectives are just able to support themselves in the lowest paid and most unskilled occupations, and no civilised government would take the responsibility of confining them, and so they go on propagating large families as stupid as themselves As Mr Lidbetter has shown,[1] it is from the ranks of just these classes that in the

[1] "Pauperism and Heredity", by E J Lidbetter, *The Eugenics Review*, vol. 14, p 152, 1923

last hundred years the majority of paupers and criminals of London has been recruited

It seems to us that in the last resort compulsory sterilisation will have to be inflicted as a penalty for the economic sin of producing more children than the parents can support Whether a man has a large or a small family is—given a healthy wife—a matter of taste, so long as he provides for his own children, but when he comes to the State and demands that it—that is to say, his neighbours—should support these children, then the State can say, "Very well—we shall help you with the family which you have, but if after this you have any more children you shall be sterilised"

Before, however, such an alternative is presented to any citizen, he may justly claim that he should receive instruction from the State in the means of birth control It is obviously unfair that such knowledge should be denied to the poor whilst it is easily accessible to the rich It is often said, and with justice, that the great objection to birth control is that the wrong people practise it But this knowledge once attained cannot be taken away, the middle classes possess it and cannot be prevented from putting it into practice If, however, the knowledge and practice of birth control were widely spread among the working class, there would be created such a resentment against the reckless production of children that the movement to establish compulsory sterilisation of the unfit would prove irresistible E W MACBRIDE

Index Londinensis

Index Londinensis to Illustrations of Flowering Plants, Ferns and Fern Allies being an emended and enlarged edition continued up to the end of the Year 1920 of Pritzel's Alphabetical Register of Representations of Flowering Plants and Ferns compiled from Botanical and Horticultural Publications of the XVIIIth and XIXth Centuries Prepared under the Auspices of the Royal Horticultural Society of London at the Royal Botanic Gardens, Kew, by O Stapf Vol 1 Pp xx + 547 (Oxford Clarendon Press, London Oxford University Press, 1929) 105s net

IN 1855 Dr G A Pritzel, who was keeper of the Royal Library at Berlin, brought out his well-known work, the "Iconum Botanicarum Index locupletissmus", being what was then regarded as an exhaustive register of all known illustrations of Phanerogams and Vascular Cryptogams, chiefly from the time of Linnæus onwards

The botanical and horticultural worlds are now able to welcome (what has been long overdue) the publication of the first volume of an emended and enlarged edition of Pritzel's work, under the title of "Index Londinensis to Illustrations of Flowering Plants, Ferns and Fern Allies" The editor of this important work is Dr Otto Stapf

About twenty years ago, the necessity of preparing a new edition of 'Pritzel' became not only obvious, but also urgent The council of the Royal Horticultural Society and Sir David Prain, the then director of the Royal Gardens, Kew, made an unsuccessful appeal for the necessary funds However, in 1912 the sum of £250 from the profits of the International Horticultural Exhibition at Chelsea formed the nucleus of a fund which made possible the commencement of the work About the year 1917 the Royal Horticultural Society began the task of organising the big undertaking which a revision of 'Pritzel' would naturally entail, and guaranteed the cost of the compilation, and at the same time received grateful help from contributors interested in the work Two committees were constituted to draw up a code of recommendations, as a result of which an honorary editor was appointed, and the work was started in July 1918 at the Herbarium of the Royal Gardens, Kew, where the director granted the use of a room and placed the resources of the library at the disposal of the staff

By the summer of 1927 a prospectus and proof page of the new 'Index' were issued At the same time, negotiations were carried on with the delegates of the Clarendon Press, Oxford, for the printing of the work In the summer of 1928, the card manuscript of the first volume, comprising nearly 84,000 references to illustrations in various books and periodicals from all over the world, was in the hands of the printers When the remaining five volumes are published, the total number of entries will amount to nearly half a million

As there were about 107,000 references in Pritzel's old 'Index', the additional 380,000 consists of those which were omitted by him and, added to these, the references to the pictorial literature published since 1865, the date of issue of the supplement to 'Pritzel' This will give some idea of the great scope of the work The references are from all publications of post Linnæan date, that is, from 1753, and extend so far as the year 1920 inclusive (For example, there are 153 references to illustrations of the common daisy) However, owing to the high quality of the pictures in certain books of pre Linnæan date, such as Rumphius's "Herbarium Amboinense" (1741) and Rheede's

"Hortus Malabaricus" (1686), these have been taken up, but not without the aid of certain modern commentaries on those works

The citations in the new 'Index' are of illustrations of Phanerogams, ferns and fern allies, the lower Cryptogams being excluded They represent 'portraits' of plants showing the habit, and of detached portions of a plant, and of such details as help to indicate the morphology of the various parts But anatomical structures and fossil plants are excluded Although teratological forms ('sports', 'monstrosities') are not, as a rule, admitted, they nevertheless very frequently occur, as no sharp line can possibly be drawn between normal and abnormal structures

No distinction is made between illustrations of species, subspecies, varieties, or hybrids, so long as they are accompanied by scientific names, and figures having only a generic name are not admitted Not more than four names (including the generic one) are used, for example, *Acer pseudoplatanus quinquelobum clausum* The spelling of plant names is in accord with the Latin as taught in modern schools, but *uniformity* is sought throughout, for example, of the two forms 'ceylanica' and 'zeylanica', the former is always used, but the latter is given in a cross reference The authors of plant names have been quoted throughout, but absolute exactitude in all cases cannot be guaranteed, especially as regards the authors of varietal names! Certain symbols are used, for example, an asterisk (*) to denote a picture wholly, or in part, coloured, a note of exclamation (!) to signify a 'sport', and (×) for a hybrid The sequence is alphabetical for the generic and specific names and the minor grades, but is chronological for the references In the matter of cross references, it should be said in the first place that, as regards species, the names under illustrations are simply registered as they are found, no attempt being made to correct inaccuracies when such occur, except when they are obviously due to inadvertent slips

When, however, as sometimes happens, these names are at variance with those which occur in the text, this fact is mentioned in the reference, and cross references are introduced under the respective quotations As regards *genera*, species are often put under generic names with which they have long ceased to be connected, a system of cross referencing has therefore been devised, based on Dalla Torre and Harms' "Genera Siphonogamarum" (1900–7), or, where this is out of-date, on modern monographs or the editor's personal knowledge

The preface, by the president of the Royal Horticultural Society, is in English and Latin The editor's introduction, giving a brief sketch of Pritzel's life and an account of the scope of the whole work, is in English only The key to the use of the 'Index', on account of its great importance, has been printed in English, French, and German This is followed by a list of subscribers

Vol 1 consists of 547 quarto pages and contains references to illustrations from *Aa* to *Campanopsis*, the letter *C* being thus split up between Vols 1 and 2 Five more volumes will appear in due course The price of the work is £5 5*s* per volume

No one who has not been actually engaged in the task can adequately realise the enormous amount of work and thought which the production of the manuscript of the 'Index' entails The delegates to the Clarendon Press are to be congratulated on the admirable way in which it is being printed While the 'Index' will scarcely be as useful to gardeners as would seem to have been at first surmised by its promoters, it will be of undoubted utility to the editors of gardening journals, to universities, and in botanical libraries like those at Kew and South Kensington

If, henceforward, the student in botany or horticulture finds the task of turning up pictures of any particular plant or plants immensely easier than he ever did before, it will be due to the facilities provided by the "Index Londinensis"

W C W

Physiological Mechanics of Piano-playing

The Physiological Mechanics of Piano Technique an Experimental Study of the Nature of Muscular Action as used in Piano playing, and of the Effects thereof upon the Piano Key and the Piano Tone By Otto Ortmann (The International Library of Music) Pp xv + 395 + 49 plates (London Kegan Paul and Co, Ltd, New York E P Dutton and Co, Inc, 1929) 21*s* net

As a treatment of the physiological mechanics of the particular motions used in piano-playing, the present volume is of intrinsic interest to comparatively few scientific workers It is of much wider interest as an example of research involving more than one of the sciences The difficulties of such research due to the ever increasing specialisation of research workers are frequently emphasised The intensive cultivation of so many small branches of the separate sciences has, however, the compensating advantage that in each the technique is so fully developed that, for

example, the mathematical physicist may well find, as did Einstein, a special mathematics ready for his application, whilst the physiologist finds that the developments of telephony provide him with electrical instruments of remarkable sensitiveness The fundamental difficulty lies in getting in touch with the required developments of the unfamiliar science, and appears to indicate not only the increasing importance of adequate indexing and abstracting of scientific literature, but also the desirability of definite training of research workers in library technique

A good example is provided by this book One would not at first associate piano playing with industrial fatigue problems, and yet Report No 14 of the Industrial Fatigue Research Board deals with "Time and Motion Study", and from its detailed bibliography we soon find that even in 1915 an elegant method had already been devised to study the motions made by workers in factories A tiny electric lamp attached to the moving limb is photographed stereoscopically to give a three dimensional record of the *path*, the light is flashed on and off again rapidly at regular intervals to indicate the *speed* of motion along the path, and the constants of the circuit are adjusted to increase the difference in the rate of brightening and dulling of the lamp filament so as to indicate the *direction* of motion It is disappointing, therefore, to find that the author of the work under notice uses merely ordinary photography of a continuously illuminated lamp attached to the pianist's hand Numerous records reproduced in the book might otherwise have yielded quantitative data There is no section on motion study in the extensive eight page bibliography

The difficulties of obtaining quantitative data on the actual muscular motion are very much greater As is clearly explained in the text, one part of a large irregularly shaped muscle may under some conditions give obvious external changes of shape, whilst another part gives no such measurable change From this it follows that precise deductions upon the movement of the whole muscle cannot be formed from observations with any apparatus which makes contact with such a muscle at a selected small part of its surface When, in addition, the contacting apparatus involves the use of the old tambour device (p 106), the results are still more unsatisfactory, and it is well to emphasise that many of the displacement-time records reproduced in the book are more qualitative than quantitative

It is stated in the preface that the experimental work has occupied five years, and that a considerable part of the time has been devoted to improvements in methods of recording There is but little quantitative data given on the new methods, and the statement on p 185 is surely a confession that the dynamograph was not always suited to the work Whilst many interesting qualitative results are given, they are almost all to be found scattered elsewhere in the writings of pianists, and the value of the research would have been very considerably increased if the author, realising that his experiments were purely physical, had taken full advantage of superior methods of measuring already available to the physicist

The avoidance of references in the text to similar work by others is undesirable in a non pedagogic scientific book, tending as it does to give a false impression of newness to the contents There is an excellent subject index, but no author index

W H GEORGE

Our Bookshelf

Experimental Building Science By J Leask Manson and Francis E Drury Vol 2 *Being an Introduction to Mechanics and its Application in the Design and Erection of Buildings* (The Cambridge Technical Series) Pp xiii + 468 (Cambridge At the University Press, 1929) 18*s* net

FOLLOWING the first volume under the same title, which dealt with the application of general elementary science to building work, the authors in this work have proceeded to develop the principles of mechanics relevant to the subject, including elasticity and strength of materials, and have applied them to the commoner forms of building construction, in such a way as to make their presentation practical and easily intelligible, without too much academic treatment The volume is in three sections The first describes the general principles governing the equilibrium of systems of forces and their application to framed structures, incidentally making reference to certain types of building plant which involve a consideration of forces in more than one plane Section 2 is mainly concerned with the theoretical aspects of elastic bending in loaded beams, and Section 3 consists of a series of chapters devoted to a practical consideration of the foregoing principles in actual work

It will be seen that the ground covered is largely the same as that in other text-books, though not necessarily in a single volume, and the advantage in the present case is that the builder and the student of building construction are provided with a manual containing, in addition to the normal traditional matter of the subject, discussions of certain important problems which are perhaps more commonly associated with the province of structural engineering, though the boundary between

the two departments is difficult enough to define Reinforced concrete thus comes in for an appreciable and appropriate amount of attention The calculation of stresses in the framed members of buildings, in which this composite material takes a leading place, it must be admitted, is now a very essential part of a knowledge of present day building construction

The treatment of the various subjects is lucid and systematic, the figures clear, and the type all that can be desired There is a serviceable index and a number of test problems with answers

B C

Life and Work in Prehistoric Times By Prof G Renard Translated by R T Clark (The History of Civilisation Series) Pp viii + 228 + 9 plates (London Kegan Paul and Co , Ltd , New York Alfred A Knopf, 1929) 12*s* 6*d* net

IT is some time since any work has appeared in English which has attempted a reconstruction of prehistoric times on the scale of M Renard's work In fact, to find anything of analogous character approaching it in completeness, we must go back to the work of Lord Avebury British writers, in dealing with prehistory, however comprehensive their scope, have as a rule confined themselves for the most part to the more or less direct evidence of archæology and the relevant elements in geology and palæontology, referring to the customs of modern primitives sparingly for illustration and elucidation only M Renard attempts a more synthetic treatment and draws largely on the data of ethnology and ethnography He treats of both material culture and social organisation In regard to the former, a more precise documentation would have been an advantage in many cases For example, in the generalised account of the origin of cultivated plants, it would have added to the value for the reader for whom a book of this type was intended had the evidence for the probable origin of cultivated plants been cited more precisely The same applies to domesticated animals, especially the dog and horse In his account both of art and of personal adornment and clothing, M Renard gives less weight to the influence of religion and magic than most archæologists and ethnologists would be prepared to allow It is difficult to admit that tattooing, for example, is, either in origin or in practice, purely a matter of personal adornment

The Practice of Spectrum Analysis with Hilger Instruments including a Note on the various Types of Emission Spectra Compiled by F Twyman Fourth edition Contributors Prof E N da C Andrade, Dr Samuel Judd Lewis, D M Smith, S Barratt, A A Fitch, J W Ryde Pp 39 (London Adam Hilger, Ltd , 1929) 1*s* 6*d* net

As the title suggests, this is a practical handbook, giving in detail the experimental procedure to be followed in the solution of various academic and industrial problems The usual arc and spark methods receive full notice with numerous references to possible difficulties, for example, confusion by adjacent lines , it is shown how these may be avoided in ordinary practice The exploded wire method for fine wires or filaments is described at length, showing, for example, how 0 2 per cent of thorium in a tungsten filament may be not only detected, but also determined, when the piece available is only 1 5 cm long and weighs one fifth of a milligram The application of the recently introduced 'R U Powder' (Raies Ultimes) prepared so as to give under suitable conditions a composite spectrum exhibiting a small number, usually about seven, of the most persistent lines of about fifty elements, is demonstrated in the text and by photographs The purpose is to identify the chief lines of all the elements in a sample by producing its spectrogram in juxtaposition with that of a portion of the R U powder Useful information is given on quantitative spectrum analysis as conducted without resort to special equipment

The chapter on the various types of spectrum discusses the theoretical bases on which the practical processes are formulated, and will be found both helpful and suggestive in the laboratory

Engineering for Masonry Dams By William Pitcher Creager Second edition Pp xiv + 294 (New York John Wiley and Sons, Inc , London Chapman and Hall, Ltd , 1929) 20*s* net

THE second edition of this text book on masonry dams is a revision to date of the earlier volume (which was reviewed in NATURE of June 20, 1918, p 301), with the deletion of certain obsolete matter and the inclusion of new data and information, making a net enlargement of 57 pages The chapter on details and accessories, in particular, has been extended so as to include a fuller description of outlet control and floodgates A quantity of relevant material has been incorporated which is included in the hydro electric handbook, by the same author jointly with Mr Justin, published in 1927

The book is, of course, mainly a reflection of American practice, and in view of the attention which is being given on the western side of the Atlantic to the development of water power and the impounding of water supplies for this and other purposes, the experience obtained and recorded in the volume is of no little interest and value to water engineers

B C

The Purple Land being the Narrative of one Richard Lamb's Adventures in the Banda Oriental, in South America, as told by Himself By W H Hudson Pp 368 + 13 plates (London Gerald Duckworth and Co , Ltd , 1929) 15*s* net.

IMAGINE Don Quixote with a dash of Scottish caution, and we have the beloved naturalist in his youth His main concern is with the pretty girls of Uruguay, and his treatise should prove irresistible to all young biologists Other scientific themes are carefully avoided, but there is all the fun of a comic revolution, which is tragic enough to draw tears—both sides of humour It is a grand book, by one of the heroes of science

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

Anent Metameric Hydrogens

AT the recent anniversary meeting of the Royal Society, Sir Oliver Lodge, with his accustomed charming perspicacity, in moving the vote of thanks to the president, referred to the happy way in which he endeavours to interpret to the old fogies the mystic feats of the juvenals who now soar into mathematical physical empyreans not only beyond the reach but also beyond the comprehension of us weak ordinary mortals Well might the Primate remark at the anniversary dinner that "the relations of religion and science have never been more cordial" This is so—not because the clerics are being made wise by 'science' but because its reputed followers are more and more walking in the clerical train and tending to write superstition for science Nothing could be further from the truth than the Archbishop's reported statement—"that both religion and science had given up the bad habit of being dogmatic" The mistake comes from the fact that, on both sides, the language used is so mystical that no one knows what it means pure hyperbole is current in both camps If coming together, it is because the body scientific is more and more being given over to dogma, doctrine and fashion, fast losing the sense of modesty and disregarding the Pauline mandate to—Prove all things!

The president, this year, has dwelt upon the picture the younger wiselings are drawing of the jinks and jazz indulged in, 'they guess', by molecules so simple and staid as we have thought those of hydrogen to be Granted the existence of two metameric forms of so primitive a molecule, attention may be directed to what *is* surprising (not the existence of varieties of the gas)—the observed prolonged stability of the one form and the influence of charcoal in effecting its rapid transformation Apparently, the change from one form into the other is no mere temperature nor time effect Physicists are apt to pay no attention to the process of change—they seem to have thermodynamic minds theirs not to reason how If the physicist have a living soul, it is one that lacks the sense of purity, he could never have paid so much attention to impure materials had he had one Electricity just passes through a gas, electrons are supposed to have no truck of convoy The evidence that chemical change only takes place in a tripartite conducting circuit is not considered, at most it is airily dismissed with a summary reference to ions—the pink silk stockings worn to day throughout the 'scientific' community—which not only can do no wrong but also are rated capable of anything and everything

A great number of instances of metameric change are known to us One of the most fundamental is that of acetoacetic ether, a compound existing in two isodynamic forms, one a keto form containing the radicle CH_2 CO , the other an enol form containing the isomeric group CH C(OH) In a highly purified state, these change so slowly that it is rational to assume that they would not change if *pure* an inconceivable worldly condition The passage from one into the other undoubtedly takes place under the influence of an *electrolytic determinant*, whereby CO becomes CX(OH) and X then walks away with an H from the contiguous CH_2—or vice versa I venture to assert this and deny that mere kinetic collision can 'do the trick'

It has long been an article of faith in my religion, that spectral lines, and now even the assumed orbital shifts in electron levels, are consequences of this order of process Like Joan of Arc, I at times am told by 'my voices' The process I contemplate is a sort of a kind of incarnation—mayhap resembling that of which Sir Oliver Lodge dreams As he would say 'I don't know' That one form of hydrogen should pass into the other when brought into contact with charcoal might, I suggest, be due to an electrolytic determinant at its surface The condensation of a gas at the surface of charcoal is undoubtedly a chemical process, one to which arguments may be applied similar to those used by Aitkon and others with reference to the formation of Water (rain drops) from hydrone The existence of two forms of hydrogen in equilibrium makes no greater call upon my imagination than does the passage of water into ice being so familiar with the fact, we in no way regard the expansion as remarkable Surely, there must be some great change in fundamental molecular contexture Water, unfortunately, has no power to day to soothe the subsidised breast of the modern researcher we are only worried by it, if it come through our roof and the valleys are flooded as it is so prone to function in waves, perhaps wave mechanicians will some day deign to notice it

We have long been aware that elementary molecules are not always fixed structures In this connexion, Sir James Dewar's remarkable but little regarded observations upon the sudden change in the specific heats of many metals at liquid hydrogen temperatures are specially noteworthy Whilst the so called atomic heat (sp ht × at wt) is almost a constant at ordinary levels, the values vary periodically at very low temperatures The alkali metals alone seem to preserve their equanimity I have always thought of such changes in elementary materials as evidence of the existence of metameric forms

Sir Ernest Rutherford speaks of a "very weak coupling" between the two states of hydrogen He also talks mysteriously of symmetrical and antisymmetrical orbital wave functions That so great a master of the art of simple expression should speak in terms so meaningless to most of us, I suppose comes from the fact that the language of wave mechanics cannot be translated down to our level It cannot be that he has joined camp with the *Jargonotropists*, protonotropist though he be When we are sufficiently quantised to be hypnotised by such terms, doubtless we shall all be worshippers of the new faith We need, however, a little more instruction before confirmation—it is difficult to recite a catechism in terms of an unknown tongue

Here the question is perhaps pertinent—Have we a known tongue to day? I notice that the heading to Sir Ernest's address is "Recent Reactions between Theory and Experiment" Should we not read guess or speculation for theory? Is not theory a sacred word, of sublime import, to be used only on royal occasions? In NATURE I fear it is almost systematically put to vulgar use—even by the great Prof Eddington, a master in the art of expression, in the issue of Nov 30, speaks of proposing "a theory" of electronic charge—which is so little a theory that he gets a value of 136 one week and 137 another Remembering him as I do, as a most active member of the Astronomical Corps de Ballet that entertained us in 1914 on the way out to Australia, I can see him gaily dancing through the scale of numbers and giving us other values in weeks to come I have been brought up to regard a theory

as a body of established doctrine, not a shifting guesswork In the same number of NATURE, in the review on the "Origin of Coral Reefs", the word is systematically perverted—it almost always is I go among schoolmasters advocating scientific method How am I to hold up my head when, in using words, my tribe is so careless? We weigh things to the *n*th decimal—but rarely our words Cannot we do something by way of example, so that our youth may not always babel on'? We have yet to learn to serve up our dish of science with proper trimmings

Even the word 'science' has no established meaning In the introduction to his recently published all comprehensive "History of Science", Mr W C D Dampier Whetham tells us that the English word science is used as a shortened term for natural science, though the nearest German equivalent, *Wissenschaft*, still includes all systematic study Surely, this is wrong 'Science' *is* 'the business of knowing', the production of knowledge, truth of whatever kind What some of us are trying to do is to exclude from it unnatural knowledge as was the desire of the early founders of the Royal Society

HENRY E ARMSTRONG

Early Rhodesian Gold

THE preliminary report by Miss Caton Thompson and the letter from Prof J W Gregory (NATURE, Nov 9) are of great interest to students of history It is well to bring forward the contradictory evidence, as Prof Gregory has done In regard to the estimate of a gold production, in ancient or medieval days, amounting to £75,000,000, I venture to express a warning The production and disposal of any such quantity of gold would have made a big stir at any time in the world's history Its commercial value in medieval days, or earlier, would be, at least, twenty times its present value, and an addition of the equivalent of £1,500,000,000 to the world's wealth would be a great event, would it not? We have no whisper in historical records of any such contribution coming from the gold mines of any region before the Californian and Australian discoveries The Spaniards obtained most of their South American gold from the graves, not the mines, of Peru, Colombia, and Venezuela Again, £75,000,000 in gold represents a weight of 625 tons

As a mining engineer, informed concerning the Rhodesian mines, I beg to submit that the estimates made by Edwards, Hammond, or others should not be accepted by archæologists, because they were made at a time when the Rhodesian diggings were being boomed on the London stock exchange Such estimates have no value for the historian The removal of 100,000,000 tons means the excavating of a vast number of cubic feet of rock, Where is the evidence of such extensive work?

As to the ingot found in Falmouth harbour, we have no evidence as to its Phœnician origin, the statement by Diodorus concerning the *astragalos*, or knuckle bone, pattern has nothing to do with the Phœnicians, he is referring to the tin trade of his own day, that is, about 25 B C, when the tin was carried overland from Corbilo, at the mouth of the Loire, to Massilia, at the mouth of the Rhone I have examined the Falmouth relic and I have seen a soapstone mould of a supposedly same type in the Bulawayo museum They have nothing in common The Falmouth ingot has a shape evidently suited for convenience in packing on horseback across Gaul We have no proof that the Phœnicians mined Cornish tin or went thither to obtain it, on the contrary, the evidence suggests that they traded with the Veneti, or their predecessors, at the mouth of the Loire, where, in Morbihan, they themselves mined for tin, and probably also traded with the Britons, meeting them on the island of Ictis as described by Diodorus The supposed identity of ingot moulds is to be taken no more seriously than the idea that phallic emblems necessarily signify Phœnician operations at Zimbabwe

T A RICKARD

Faculty Club,
University of California,
Nov 25, 1929

DR RICKARD's letter carries the weight of his high authority on early mining Yet the estimates of the great gold output from Rhodesia were not made on the London Stock Exchange, but by responsible mining engineers who were well acquainted with the ancient workings When discussing Telford Edward's estimate with the local authorities in 1905, they expressed the view that his figure would have to be increased owing to the discovery of many additional workings In view of the size and number of the ancient mines, I felt that the excavation from them of 100 million tons was not exaggerated The workings are direct evidence of an output of gold which as Dr Rickard says, would have made a stir in the world The discoveries at Ur and in Egypt show that the people of those countries had tons and tons of gold If the Rhodesian gold mining had been medieval, we should surely have evidence of it in the gold or by tradition

In view of the suggestion that the gold was mined in connexion with the Arab settlement of the East African coast, I recently asked Sir Robert Hamilton whether he knew of any evidence of the Arabs there having had any large quantities of gold He replied "I have seen and myself collected a few gold and gold inlaid ornaments on the coast, some, the majority, were obviously not very old, being made out of sovereigns, others were older, those mostly from Lamu and Patta, which generally appeared to be of Persian origin or design In any case the amount was trifling On the other hand, old swords and daggers which are often treasured possessions, are generally hilted and adorned with silver work of Arab origin While there are traditions of wealth in ivory and slaves I have never come across traditions of wealth in gold or of trading in gold, and so far as my reading of history goes I do not recollect any recorded accounts of the early European discoverers and explorers on the E coast finding the Arabs in possession of wealth in the shape of gold nuggets, dust, or ornaments The evidence is naturally defective and negative, but I should hesitate to believe that the medieval coast Arabs possessed gold in any quantity without a great deal more positive and convincing evidence than I have yet seen"

In reference to the Falmouth tin ingot, the stamp on it has been described as the mark of a Phœnician or Greek trader The ingot was accepted as Phœnician by the best opinion of the time of its description by Sir Henry James, for Lord Leighton, who was careful to obtain the best expert advice, pictured it in his fresco in the Royal Exchange of the Phœnicians trading with the ancient Britons Dr Rickard remarks that this ingot and the Zimbabwe ingot-moulds have nothing in common Their similar shape seemed to me so significant that I published outline drawings of them, to show their resemblance, in *Trans Inst Min Eng*, vol 31, 1905–6, Pl I Figs 2 and 3 The loss of the ingot near the entrance to Falmouth Harbour was attributed by Sir Henry James to the boat having been wrecked while seeking shelter there "on its voyage coastways to Boulogne"

Some of the tin for Phœnicia may have been carried across Gaul to Marseilles from the mouth of the Loire, but the use of the Boulogne route for the Cornish tin has been generally accepted

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The Product of the Radioactive Disintegration of Potassium

IT has been shown by numerous investigators that potassium and salts of potassium are radioactive, the activity being due to the emission of β particles by the atoms of potassium In accordance with the radioactive displacement law, Hahn and Rothenbach (*Phys Zeit*, 20, p 194, 1919) pointed out that this β-transformation of potassium should result in the production of an isotope of calcium, without change in atomic weight On the other hand, S Rosseland (*Zeit f Phys*, 14, p 173, 1923) has put forward an ingenious suggestion which does not necessitate the production of a calcium isotope Later, Hevesy and Løgstrup (*Zeit anorg Chem*, 171, p 1, 1928) showed experimentally that the radioactivity of potassium appears to be confined to the isotope of mass 41, Aston had previously shown that potassium consists of two isotopes of masses 39 and 41 If only the isotope of mass 41 is radioactive, Holmes and Lawson (*Phil Mag*, 2, p 1218, 1926) worked out the half value period of this isotope, and on the basis of this result, Hevesy and Løgstrup calculated that, if we assume the earth to have existed for 10^9 years, about 0 001 of all the potassium in the earth must have been trans formed into calcium of atomic weight 41

As a result of an examination carried out by one of us on a series of samples of microcline from Miask (Urals), a variety has been found containing 11 per cent of potassium and only 0 042 per cent of calcium In accordance with the calculations of Hevesy and Løgstrup, there should be present in this mineral about 0 01 per cent of Ca^{41}, which has been generated from potassium during the life of the mineral, assumed to be 10^9 years If the remainder of the calcium (0 03 per cent) were present in the mineral during its formation, and if it had the atomic weight of ordinary calcium (40 07), we have calculated that the total calcium in the above mineral should have an intermediate combining weight of 40 30

Through the kindness of Mr Smolianinoff, director of the Mineralogical Museum of the First Moscow State University, we have been able to obtain a quantity of this mineral microcline, from which 0 15 gm of CaO was extracted After careful purification by repeated precipitation as $CaSO_4$ and CaC_2O_4, in quartz vessels and using carefully purified reagents, the atomic weight of the resulting calcium was determined by evaluation of the ratio $CaCl_2$ $CaBr_2$, the weighings being accurate to 0 01 mgm Two determinations yielded concordant results, 40 21 and 40 24, as compared with the calculated value of 40 30 The slight discrepancy can be explained by the loss of part of the calcium during its long sojourn in the earth's crust

In order to examine the accuracy of this method of determining the atomic weight and the efficiency of the method of purification, ordinary calcium (Merck's 'calcium carbonate') was mixed with salts of barium, strontium, magnesium, aluminium, and iron, and then extracted and purified by the same methods as had been used for the calcium from the microcline The atomic weight of this calcium was then determined, and the results of three experiments gave respectively, 40 06, 40 16, and 40 08, as compared with the value 40 07 of T W Richards The mean of these three results is 40 10

It is our intention to continue this investigation, and to determine accurately the atomic weight of calcium from microcline, by using a larger quantity of the material

A V FROST
O FROST

Vasily Island,
Leningrad

WE are indebted to the Editor of NATURE for the privilege of reading the above interesting communication, which, so far as it goes, seems to indicate a calcium isotope of mass 41 as the disintegration product of potassium

In view of the uncertainty which is likely to arise from the use of so small a quantity of material (0 15 gm CaO), and the rather large difference (0 1 unit) between the extreme values of their three determinations with ordinary calcium, we shall look forward with interest to the results of the authors' projected work with larger quantities of material

The suggested explanation of the discrepancy between the experimental and calculated atomic weights of calcium from microcline would surely tend to make the experimental value higher instead of lower than the calculated value It would be predominantly 40 07 calcium that would be involved if calcium were lost during the life of the mineral

The calculated value of the atomic weight of the calcium from microcline is necessarily far from trust worthy, as it involves not only the uncertainty of the disintegration constant of potassium, but also an undoubted error in the age assigned to the microcline According to Backlund, the pegmatites of Miask are younger than the biotite granite of the region and the cataclastic deformation that followed that is to say, they are a little younger than the orogenesis of Artinskian (Lower Permian) time Stratigraphically they are directly known to be younger than the Middle Carboniferous As von Bubnoff has pointed out, sedimentary deposits younger than the Middle Carboniferous are not known in the East Urals, and exact time definition is therefore not practicable

It is nevertheless clear that the age to be considered in making the atomic weight calculation should be not 10^9 years, but rather less than 2×10^8 years Adopting the latter figure, the amount of Ca^{41} in the extracted calcium from the microcline would be only 5 per cent as against 25 per cent previously assumed It is here tacitly assumed that the average atomic weight of ordinary calcium was the same 2×10^8 years ago as it is now There is no means of estimating the difference, but as it is in any case quite inappreciable, it may safely be ignored For an age 2×10^8 years the atomic weight of the microcline calcium is calculated to be almost exactly 40 1

ARTHUR HOLMES
ROBERT W LAWSON

Measurements of Noise by Means of a Tuning-fork.

IN recent work I have been assessing the loudness of certain noises by means of an audiometer of the type in which a note in a telephone earpiece over one ear is adjusted in loudness until it appears to be as loud as the noise observed by the other ear, or alternatively, is just masked by it For general observations of everyday noise when the instrument is not at hand, I find it possible to use a tuning fork on the same lines The fork is struck in a standard manner, and note is made of the time which elapses before the loudness of the fork, when placed as close to the ear as possible with the flat of a prong facing the auditory meatus, falls to the loudness of the observed noise

The total interval which elapses before the fork is masked by the noise is also taken for check purposes.

Since the sensation stimulus law of the ear and the law of decay of the fork vibrations are both practically logarithmic, it follows that equal intervals of time give approximately equal reductions in the loudness of the note from a struck fork. The fork actually used had a frequency of 640 vibrations per second. The intensity of the note when the fork was first struck was about 90 decibels[1] above the threshold and it died away to inaudibility in about 62 seconds. The average rate of decay was thus about 1½ decibels per second. Actually it was found that the decay of the fork was rather greater at large amplitudes than at small—a fact that may be associated with an observed drift in the performance of the fork during the months it has been in use. Since it was known that the pressure variation in the minimum sound of this pitch audible to the observer's ear was about 1 millidyne per sq. cm., the scale of the loudness of the fork is an absolute one.

By extrapolating an approximately average linear relation found to exist for moderately loud noises between 'equality' results and 'masking' values, it was possible to use 'masking' values alone in assessing noises which were louder than the fork, and the scale was thus extended to 110 decibels above the threshold.

A number of observations of the ordinary level of daily noise taken over a period of some months have been summarised in the table. It is not claimed that the table is complete, or that conditions were always average, but consistency and reasonableness were revealed when observations made over a period of some months were summarised. For example, an accelerating bus gave the same result when observed in Regent Street as when observed on a quiet night in Teddington. A really busy street was practically as noisy at Kingston as near Oxford Circus in London, and had the general loudness of accelerating cars and buses. Experiments in the first and third class compartments of a certain train revealed that the noise levels were about the same until the windows were closed, and then the first class compartment was definitely the quieter by some 5 decibels or so.

Loud radio speech at home corresponded with really loud conversation, and transmission through a 4½ in. brick wall into an adjacent room reduced the level by some 30 decibels to that of rather quiet conversation. In an interesting case where complaint was made of the noise from a loud speaker which could be heard up and down a residential street, the loudness observed through open windows in a room in the house on the opposite side of the street was also of conversational level. The fatigue of conversation in busy streets, trains, buses, trams, and noisy restaurants, is to be expected from the fact that the level of noise is generally greater than that of conversation.

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LOUDNESS LEVELS OF VARIOUS NOISES

Fork Loudness (Decibels above Threshold)	At Home	In Street	In Vehicles	Miscellaneous
130				Threshold of painful sounds
120				
110				Aero engine (10) (unsilenced)
100				Express train (12) (estimated)
90		Pneumatic drill (20)	Tram on v. noisy rails	
80	V. l. radio music	Motor horn (20)	Tube train	
70	L. radio music	V. busy traffic accelerating cars and buses	Bus top. Tram. Train (open windows)	Electric train starting. V. noisy restaurant. Typewriter
60	L. radio speech	Busy traffic	Saloon car (35 m.p.h.)	
50	Q. radio music. Conversation	Q. car. Q. street, behind Regent St.	Train (windows shut), 1st class	Moderate restaurant clatter
40	L. whisper (5). V. q. radio		Saloon car (25 m.p.h.)	Q. restaurant in Strand
30		Q. street, evening, no traffic, suburban		Walking on gravel. Rustle of leaves in wind
20	Q. garden			
10	Q. whisper (5)			

(Q = quiet. L = loud. Figures in brackets are distances in feet from the source.)

[1] A change of 1 decibel—a power step of $10^{0.1}$ fold or 1.26 fold—is of the order of the minimum difference in loudness detectable by the ear.

Thames Floods and Pollution

The note on the Thames flood of 1928 (Nature, Jan. 4, p. 32) is of the very greatest topical interest, for not only have the recent December floods covered an unexpectedly large area, again submerging districts upon which council houses have been built, but they have also shown how river pollution must rapidly increase as fields get replaced by residential quarters with drainage systems far below the level of the river.

According to the old order of Nature, flood waters used to accumulate above Oxford, perhaps submerging the water meadows for weeks at a time, but at any rate much water was there ponded, helping to save from

serious flooding more valuable lower reaches of the Thames nearer London Recent experiences seem to show that the Conservators of the Thames are changing this By costly enlargements of weirs, channels, and bridges, the water is hurried down from the upper pastures on to the residential areas below These areas, being land liable to flooding, would never have been built upon but for the optimistic parrot cry of 'No more floods', whenever some notable work of river engineering has been accomplished Either in spite of what has been done, or in consequence of it, the failures have been so frequent and so costly, that the time is ripe for a thorough and scientific investigation of very complex problems that need never have arisen The river is no longer adequate to meet all the requirements of those huge and increasing populations that have settled within its watershed It therefore becomes necessary to define the objects of primary importance that are served by the Thames, and what should be subordinated thereto

That there are good grounds for mistrust in the future is shown by a recent publication, "The Thames Valley from Cricklade to Staines", in which the urgent duty of the preservation of the beautiful and beloved 'landscape character' of the river is most strongly advocated But it behoves a scientific statesman to approach the subject from a rather different point of view

The essential of a river is not its setting, but its water London draws a large percentage of its drinking water from the Thames Oxford and Reading are equally dependent upon it The few barges and factories upon the upper reaches are surely matters of small consequence as compared with London's need of pure water Birmingham, Liverpool, Glasgow have all acquired Nature reserves as catchment basins for their water supply, and take extraordinary precautions to preserve the purity of their sources Streams that are possible sources of pollution have been diverted, dwelling houses have been pulled down, tenants have been evicted, the very hillsides have been rationed in the matter of grazing cattle The result is a city supply of a beverage that is worth drinking London has been strangely apathetic in the matter, with the result that she drinks the bath water of other towns indeed, much of her 'water' is stuff to which that blessed word 'effluent' has been applied several times over Oxford drinks the effluent of factories on the upper Thames and its tributaries, and puts effluent back into the river at Kennington for the benefit of towns below Similarly, Reading uses what it desires, and excretes an 'effluent' for others Finally, the water after final chlorination is served in the flat form familiar to the citizens of the capital city of the Empire

All through the drought of the past summer, the stagnant river had barely current enough to shift an oily scum, derived from motor boats and the washings of motor-cars This scum is most harmful to bird and animal life, and is most deterrent to picnickers During the past month the upper Thames has suffered pollution through the gushing of sewage from low lying drains into the Thames, by the washing out of gas-water from a huge gasometer into the river—and water over which coal-gas has been standing is perhaps one of the most deadly of effluents to fish life, and by the unhindered flow of inky black effluent (untreated) from the refuse dumps of Oxford directly into the Thames It is obvious that the river is also receiving water that has been slowly flowing over acres of manured allotment grounds, and through thousands of ill-kept back yards of slum houses Everything soluble, and much that can be carried in suspension, will go floating down stream to the intakes of the Water Board We admire their assiduity in sterilising and their success in preparing drinking water from such polluted sources

The real question to be settled is why precautions which are taken to preserve the purity of the water of Lake Vyrnwy or Lake Thirlmere should not be applied to the Thames The scheme of confining the river to a narrow canal would be costly, inefficient, and inexpedient, but the preservation of a natural river flowing beside a definite flood zone of water meadows, free from exceptional sources of contamination, would be Nature's own way of dealing with the needs of the Thames

An independent potamological station for the scientific investigation of the Thames has often been suggested It could perform a national service now

R T GUNTHER

Visible Electron Diffraction

UNTIL now diffraction of electrons has only been made evident by delicate electrometric measurements or by photographic exposures of several hours I have succeeded for the first time in making visible on a fluorescent screen diffraction rings produced by a crystalline powder This latter is a thin film of zinc oxide obtained according to the process described by M Ponte (*Comptes rendus*, **188**, 244, Jan 1929) This film is formed by an agglomeration of microcrystalline particles of smoke and possesses marked electrical conductivity While working the tube, one can bring a given sample or a given area of the sample into the

FIG 1 —Diffraction rings of zinc oxide
$V = 19$ k v $D = 13$ cm exposure = 10 seconds

path of the electron beam With a current of some tenths of a milliampere and a voltage exceeding 8000 volts between the cathode and the collimator tube, the two principal rings of zinc oxide are easily visible (Fig 1) They are some tenths of a millimetre wide and some centimetres in diameter

One can follow on the screen their variation in diameter according to the voltage The moving of a magnet near the tube displaced the entire diffraction pattern Using ordinary photographic plates, the necessary time exposure under 15 k v. pressure does not exceed ten seconds The law of M Louis de Broglie is easily verified with an approximation of a few hundredths The sight on the screen of movable rings of a variable diameter seems thus to provide the most direct and convincing proof of crystalline electron diffraction

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Paris, Nov 18

Reflection of Protons from Calcite

I HAVE recently found that hydrogen canal rays give a complex reflection pattern when they are allowed to fall on a cleavage face of a calcite crystal at almost grazing incidence Fig 1 shows one of these patterns The crystal was placed horizontally and was held by a wire spring bearing on the top A narrow bundle of the rays struck the crystal underneath the wire, which was not in absolute contact with the crystal at the centre point Some of the canal rays passed over the surface of the crystal without hitting it and fell on the photographic plate 15 5 cm distant, giving rise to the central spot seen in the lower part of Fig 1 This spot appears white because of solarisation of the plate due to the concentrated neutral bundle

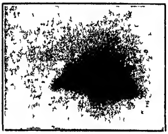

FIG 1

The upper part of the photograph shows positive particles reflected from the surface of the crystal It consists of a series of curved and straight lines forming a regular pattern which is not perfectly symmetrical about the vertical axis By increasing the angle of incidence the central spot was cut off and the figure was considerably altered The figure has a certain resemblance to the secondary lines obtained by many authors with X rays, using the rotating crystal method of analysis (Sir William Bragg, "An Introduction to Crystal Analysis", 1928, p 38), however, the angular divergence of the original bundle was scarcely large enough to give the variation in the angular deflections actually observed, and the Bragg equation gives far smaller angles than those observed if we assume an equivalent wave length from the de Broglie formula A more promising interpretation is that the lines are due to diffraction of the rays at the two dimensional gratings formed by the rows of atoms in the crystal surface With the de Broglie wave length, the angles deduced are of the right order of magnitude

FIG 2

By applying a magnetic field it was found that the whole pattern was shifted as shown in Fig 2 The arrow shows the direction of the force on a positive particle, and its length indicates the distance in the figures that subtends an angle of 0 01 radian As the blackening of a photographic plate by positive hydrogen canal rays is chiefly due to charged hydrogen atoms, we may conclude that the pattern is caused by the impact of protons The maximum potential on the discharge tube was approximately 40,000 volts, and a magnetic analysis showed that the positive ions were distributed over a considerable range of energies

Since the magnetic field does not destroy the lines, we may consider the different points as corresponding to particles of different velocities A line is thus a velocity spectrum of the protons, or, in terms of wave mechanics, a diffraction spectrum of their equivalent wave lengths It is very significant that no undeflected pattern was observed, although neutral hydrogen atoms are present in large numbers in a canal ray beam The theories of wave mechanics would not at present distinguish between the wave lengths associated with a proton and a neutral atom of the same velocity

A J DEMPSTER
Ryerson Physical Laboratory,
University of Chicago, Nov 26

Nature of Disease-Producing Viruses

IT has been pointed out on more than one occasion that, if filterable viruses constitute a group of ultra microscopic organisms, it is remarkable that no saprophytic forms are known In NATURE of Aug 17 last (p 267), Dr J J Davis questions the validity of this argument, at least in the present state of our knowledge "Until viruses can be known other than by the effects of their parasitism, it would seem to be quite impossible to detect corresponding bodies that are not parasitic," he says, and "until some method is devised by which the constituents of the virus can be recognised, it would seem to be useless to look for them"

In other groups of micro organisms, however, numerous forms are known, which, though normally parasitic, are yet facultative saprophytes which can be cultivated on artificial media as well as on their natural host So far, however, no one has been able to cultivate a virus on an artificial medium Re inoculation into the natural host should provide a perfectly valid test for the success of such saprophytic cultivation if it occurred There is thus a very distinct gap between the viruses and known types of living micro organisms indicated here

Again, in the case of the normally saprophytic, bacteria almost on the borders of visibility can be cultivated on solid media, forming colonies visible even to the naked eye But no colonies which might be considered those of a saprophytic virus have ever been observed on artificial media, whether on agar, gelatine, or silica gel

There are other facts which make it difficult to imagine the viruses as a group of micro organisms of somewhat the type we know in the bacteria or protozoa, only much smaller in size It would seem preferable, therefore, to keep an open mind for the present on the subject of what a virus really is, and to continue experimental work, rather than to postulate already a "hypothetical intermediate combining molecular structure, metabolism, and reproduction", and to term it a vitamol In fact it is difficult to see the distinction between *vitamol* and *virus*, and the former term is objectionable in giving a certain definiteness of ideas as to structure which our present knowledge does not warrant

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Some Bands of the Carbon Molecule

THE spectrum of a condensed discharge in hydrocarbons contains, besides the well known CH and the Swan bands and some other less prominent bands, a strong system, the structure of which does not seem to have been investigated before We were able to photograph these bands in the second and partly in the fourth order of a 21 ft concave grating, and could thus resolve completely the rotational fine structure. The bands have a very strong resemblance to the Swan bands and undoubtedly arise from the same

molecule The bands investigated fit into the following scheme (wave lengths of the heads)

n' \ n''	0	1	2	3
0	*3852 1*	*4102 3*		
1	*3607 3*	*3825 6*	*4068 2*	
	3399 8	*3592 9*		*4041 9*
3		3398 1	3587 7	

The seven bands given by figures printed in italics have been investigated for fine structure Combination relations prove the correctness of the scheme

Each band consists of two P and two R branches Alternatively, the red and violet doublet components are missing This fact, which is very striking even on a rough inspection of the plates, proves that the bands must be due to a symmetrical molecule and that the nuclear spin of the atoms in question is zero There is therefore scarcely any other possibility but that the bands come from a C_2 molecule, which has also been made responsible for the Swan bands The lines are sharp and single, and our plates allow us to say with a very high degree of probability that three lines near the origin are missing The terms can be represented with great accuracy by the usual quadratic formula const $+B(j+\frac{1}{2})^2-\beta(j+\frac{1}{2})^4$ All these facts show that we have here a $^1\Pi \longrightarrow {}^1\Pi$ transition, and we believe that the electron configuration (except, of course, the orientation of the spins) is the same as that of the terms of the Swan bands

The molecular constants calculated from these bands are very near to those of the Swan bands, but they can be obtained with much greater facility and accuracy because of the simpler structure of the bands We give here the values of some of the constants It is possible that the final values, which will be calculated with the help of the complete material, will be slightly different

	B'	B''	J'	J''	ω_0'	ω_0''	ν_0
$^1\Pi \longrightarrow {}^1\Pi$	1 7732 1 7744	1 6086 1 6081	15 62	17 22	1764 9	1584 2	25969 16
$^3\Pi \longrightarrow {}^3\Pi$ (Swan bands)	1 750	1 626	15 84	17 03	1752 4	1618 1	19373 87

In this table $B=h/8\pi^2J$, J moment of inertia, ω_0 the difference between the first and the second vibrational state, and ν_0 the origin of the $0 \longrightarrow 0$ band The constant a which determines the degree of coupling of the orbital moment of momentum to the nuclear axis and therefore the 'σ doubling' is roughly $5\ 9 \times 10^3$ for the initial and $1\ 3 \times 10^4$ for the final state

Full particulars will be published elsewhere

G H DIEKE
W LOCHTE HOLTGREVEN
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The Muscular Sense

IN reference to the note by Prof Fraser Harris on the "Subjective Demonstration of the Existence of the Muscular Sense", in NATURE of Nov 23, I beg to point out that so far from the existence of this sense being demonstrated by the simple experiment he describes, he has really got no further than the indication of the nature of the problem William James was well acquainted with such evidences, yet he decided that the muscular sense was a "needless encumbrance" My own position is different from both, the muscular sense, or as I call it, the sense of effort, has an existence, but the affirmation of Prof Fraser Harris or the denial of William James has no particular weight, as neither is based on any analysis of a searching character.

The question is not whether a distinct sensation is perceptible in the act of raising the arm, as in the example of Prof Fraser Harris, but whether this sensation is determined by, and entirely explained by, the production of the efferent nervous stimulus necessary to activate the muscular system involved

The question of the sense of effort is one of the most elusive in the whole range of psychology, and I did not find it possible to offer a definite answer until I had completed the analysis which led to the formation of the "Fundamental Processes of the Mind" Once the meaning of these processes is grasped, such problems of psychology become susceptible of solution A complete explanation on the physical side demands a minute examination of a long series of neurological phenomena

Nothing of this is suggested by Prof Fraser Harris, while on the part of William James, though he had intuitions of the necessity of ascertaining the Fundamental Processes, he has not given us even the beginning of a valid analysis to that effect Those who are interested will find that analysis set forth with the necessary rigour in my "Principles of Psychology"

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Occurrence of *Cepedea* in Frogs

WHILST examining a number of *Rana temporaria* for intestinal protozoa recently, I encountered one single frog infested with a species of *Cepedea* (Protozoa, Ciliata, Opalinidæ) So far as a survey of the available literature has revealed, the only previous record of the occurrence of a species of this genus in *R temporaria* is that of André (*Rev Suisse de la Zoologie*, vol 21, p 6, May 1913), who reports the occurrence of *Cepedea dimidiata* in frogs of this species obtained in Switzerland

The species recorded here has not yet been examined in sufficient detail to enable me to state whether it is *C dimidiata* or not, though a cursory examination has shown it to differ appreciably in size from typical *dimidiata* obtained from *Rana esculenta* Out of a large number of frogs obtained and examined either by me or in the course of class work, no others have shown the presence of this species, unfortunately, I have not been able to determine the locality from which they were obtained, apart from the statement that they were collected in England

W REES WRIGHT
The Victoria University of Manchester,
Dec 16

The Secondary Split in the Maturation Divisions of Liliaceous Plants

APPROPRIATE destaining in mid pachytene has disclosed two, and only two, rows of genes, minute bodies nearly at the limit of microscopical vision Repeated observations have shown that the sets of four chromioles seen at late pachytene are united in two pairs, like two dumb bells, one on each side of the primary split Here the secondary split has not yet been completed Observations of diplotene in *Lilium*, *Fritillaria*, *Kniphofia*, and *Allium* have proved that there is only one split visible throughout, even at the nodes Hence I agree with Gelei, who also made an intensive study of the pachytene stage, that the primary split alone opens out at diplotene

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The Discovery of Tertiary Man[1]

By Prof HENRY FAIRFIELD OSBORN, For Mem R S, Research Professor of Zoology, Columbia University, Honorary Curator of Vertebrate Palæontology, American Museum of Natural History

THE discovery of Quaternary man was the central biological achievement of the nineteenth century For twenty four centuries the largely speculative idea of a natural rather than a supernatural origin of man had been slowly developing through the observations of zoologists and the dissections of comparative anatomists From the time of Anaximander (B C 547), of Galen (A D 131), of Leibniz (1700), of Buffon (1755), of Goethe (1790), of Erasmus Darwin (1794), of Lamarck (1809), of Chambers (1844), of Leidy (1847–73) to that of Charles Darwin (1859–71) one bit of evidence after another was added from comparative anatomy, until in the sixteenth century comparative zoology contributed the strong likeness to man of the anthropoid apes—the chimpanzee and gorilla of Africa, the gibbon and orang of eastern Asia The most significant and prophetic observations in comparative anatomy were those of Goethe in the discovery of a separate intermaxillary bone in the upper jaw of man which both he and Leidy rightly interpreted as linking man with the apes and other primates in which the upper jaw is composed of two bones Up to 1859, the relatively new science of palæontology had thus far contributed nothing because the female Neanderthal skull of Gibraltar in 1848 and the male Neanderthal calvarium of Germany in 1856 were misinterpreted by Virchow, Huxley, and other anatomists

I emphasise comparative anatomy and zoology, for as regards *direct* evidence our speculative position toward Tertiary man in 1929 is very much the same as Lamarck's and Darwin's speculative position toward Quaternary man between 1809 and 1871, because we are still largely dependent upon the facts afforded by comparative anatomy and comparative zoology, in the absence of direct palæontological evidence in Middle and Lower Tertiary time This statement is not true as regards *indirect* evidence, for human palæontology is now in a very strong position even to the very base of Quaternary time, a period estimated by geologists at 1,250,000 years Fossil human remains of more than a hundred Quaternary individuals have been found, including *Palæanthropus Neanderthalensis* of Neanderthal, 48 +, *Homo sapiens* of Cro Magnon and Chancellade, 42, 2 of the Trinil race of Java (1891), *Pithecanthropus erectus*, 2 of the Piltdown race, *Eoanthropus dawsoni* 1 of the Heidelberg race, *Palæanthropus Heidelbergensis*, also 1 and possibly 2 more individuals recently reported by Freudenberg under the name *Hemianthropus*, 27 of the recently discovered Chinese *Sinanthropus Pekinensis* (Schlosser, 1903, Zdansky, 1926, Black, 1927–28)

All these human fossils constitute a firm and broad human palæontology for Quaternary time and the close of Tertiary time Each generic name, for example, *Palæanthropus*, *Pithecanthropus*, *Eoanthropus*, *Sinanthropus*, and *Homo*, demonstrates an entirely distinct branch of the fossil human families of Quaternary time, each branch is known to palæontologists as a *phylum* and the special scientific analysis of these several branches is termed *phylogeny* Phylogeny is a relatively new and very important branch of biology, the principles of which were entirely unknown to Darwin (1859–71) and only in part known to Huxley, as they are now revealed by the brilliant and world wide discoveries by invertebrate and vertebrate palæontologists My forecast of the Tertiary anatomy and habits of the 'dawn man is greatly influenced by our direct knowledge of the phylogeny of other mammals

As Quaternary fossil man was the central biological contribution of the nineteenth century so Tertiary man constitutes the goal and peak of biological discovery in the twentieth century Thus far I have been dealing with well known facts because these Quaternary fossil men have become household words all over the world On the other hand, the discussion of Tertiary man carries us into the unknown, into one of the most interesting fields of human speculation and anatomical controversy, into several divergent camps of human opinion and interpretation, along several great lines of comparative anatomy of the principal organs concerned, namely, the brain, the skull and jaws, the limbs, the hands and feet Both with Lamarck and Darwin the 'ape men' descent was never more than a working hypothesis based upon the closer approach of the anthropoid apes to man than that observed in any other group, for want of any positive data Both Lamarck and Darwin postulated a *reversible* evolution in function and structure whereby an animal with all the psychical and anatomical adaptations of arboreal apes could secondarily take on a gradual change of habit and function and gradually enter a new erect career with radical changes in habit and in mind as well as in the anatomy of limbs, hands and feet Darwin's starting point (1871), after picturing as our ancestor a hypothetical ape not far from a primitive Miocene chimpanzee, concluded with the following all important sentence both as to habit and habitat

The foot was then prehensile, judging from the condition of the great toe in the fœtus, and our progenitors, no doubt, were arboreal in their habits, and frequented some warm, forest clad land

More recently (August 1927), in his presidential address to the British Association, Sir Arthur Keith summed up this hypothesis as follows

DATE OF MAN'S EMERGENCE —It is useless to go to strata older than the Miocene in search of man's emergence, in such strata we have found only fossil traces of emerging anthropoids All the evidence now at our disposal supports the conclusion that man has

[1] Retiring presidential address delivered before the American Association for the Advancement of Science at Des Moines on Dec 27, 1929

arisen, as Lamarck and Darwin suspected, from an anthropoid ape not higher in the zoological scale than a chimpanzee, and that the date at which human and anthropoid lines of descent began to diverge lies near the beginning of the Miocene period On our modest scale of reckoning, that gives man the respectable antiquity of about one million years

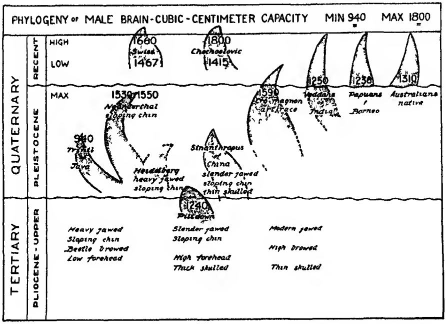
This Lamarck Darwin working hypothesis has been greatly strengthened and in large measure adopted by an army of human and comparative anatomists including all the leading and most brilliant men of our time, such as Sir Arthur Keith (1927), Prof G Elliot Smith (1926–29), Prof William King Gregory, Dudley J Morton, and Robert M Yerkes, as well as by a host of other able but less widely known anatomists So great has been the force of nearly unanimous adherence to the Lamarck Darwin hypothesis that it has gained world-wide acceptance even among the most intelligent scientists, as may be seen in passages in two outstanding works of the present decade, Eddington's "The Nature of the Physical World" (1928) and Jeans's "The Universe Around Us" (1929) A parallel instance of the world wide assumption of a working hypothesis is that of Lamarck's hypothesis of the inheritance of acquired characters as the prime cause of evolution Although never demonstrated, the Lamarckian hypothesis was universally accepted until Weismann gave it a death-blow in 1880 Such may be the fate of the 'ape man' hypothesis

I was myself rather suddenly converted to the opposite 'dawn man' hypothesis in a roundabout manner When in 1919, after years of search, the American Museum discovered in Middle Pliocene time the complete skeleton of a horse named *Pliohippus leidyanus*, a perfect horse in all except name and perhaps colour, the bearing of this case of precocious adaptation on human descent flashed across my mind, and before a meeting of the National Academy of Sciences I predicted that the greatest surprise in store for twentieth century science would be in the discovery of a large-brained Tertiary man! This anatomical prophecy has unexpectedly been confirmed by recent palæontological evidence that *Eoanthropus*, the 'dawn man' of Sussex, is of Upper Pliocene or Tertiary age

The large brain of *Eoanthropus* suggests as our first quota of counter evidence a review of our greatly enriched knowledge of the Quaternary fossil brain

BRAIN SURPRISES OF QUATERNARY DISCOVERY

These surprises arise from the profound researches and independent discoveries of Dubois, Smith Woodward Boule, Keith, McGregor, Black, Economo, and Leboucq, to which honour roll we should add Frederick Tilney's "The Brain from Ape to Man" (1928) The six outstanding points as to the brain are as follows (1) that certain races of fossil man of the last 1,250,000 years had a brain cube equal to or greater than that of modern man, (2) that the much despised cave man (*Palæoanthropus*) was inferior to ourselves neither in brain cube nor in hand ability, although far inferior to ourselves in civilisation, (3) that certain of the cave men (*Homo sapiens* Cro Magnon) were our superiors both in average brain capacity and in average artistic ability, (4) that at the close of Tertiary time there lived a race (*Eoanthropus dawsoni*) with a brain cube equal to the minimum of that of the living Veddahs, Papuans, and native Australians, (5) that the ratio of human brain weight to body weight in Quaternary time was



Photo] [American Museum of Natural History New York

FIG 1

apparently the same as it is to day, namely, 1 50 (Weber, 1896), in contrast to the anthropoid apes, in which it is as follows

	Brain to body weight ratio
Super arboreal Gibbon of south east Asia (130 gm)	1 66 or 1 73
Arboreal Chimpanzee of west Africa (412 gm)	1 51 or 1 61
Super arboreal Orang of Borneo (400 gm)	1 183 or 1 194
Terrestrio arboreal Gorilla of central and west Africa (565 gm)	1 150 or 1 200

(6) as Dietrich has shown, *Pithecanthropus*, the Trinil race of Java, is not an ancestral Pliocene type, as was formerly supposed, but a surviving mid Pleistocene branch, the companion of a stegodont elephant, the Trinil brain is a case of arrested development

The conclusion is inevitable that *the main cubic evolution of the human brain took place during ante cedent Tertiary time and not, as we formerly thought, during the Quaternary age of man or Glacial period*

These six points are supported by the following comparison

	Brain cube in c c
Summit of Quaternary and *Modern* time	
Homo sapiens, Cro Magnon of Mentone	1550
Palæanthropus, Neandorthal Caveman, La Chapelle aux Saints	1530
Homo sapiens, average modern Swiss	1467
,, ,, average modern European	1450
,, ,, Alpine race of Czechoslovakia	1415
,, ,, fossil Alpine race of Ofnet	1400
,, ,, native Australian race	1310
,, ,, native Indian Veddahs	1250
Mid Quaternary	
Pithecanthropus erectus (Trinil man of Java)	940
Summit of Tertiary	
Eoanthropus dawsoni (Piltdown Dawn Man)	1240
Living Papuans of New Guinea	1236

It is well known that the *brain cube* is not a trustworthy test of brain power or capacity, as Leboucq has recently pointed out in striking examples from recent times

	Brain weight in grams
Tourgenieff, Russian novelist	2,012
Cuvier, founder of palæontology	1,829
Byron, poet	1,807
Gambetta, statesman	1,246
Anatole France, littérateur	1,017 (to 1,317)

Doubtless this *cube versus intelligence* disparity in brain function also prevailed during the Quaternary age of man, although in the few fossil cases where comparison is possible we note a similar disparity between male and female brain weight

We must, therefore, adduce collateral and very substantial proof that Upper Tertiary man, whom we may provisionally designate 'the dawn man' after Smith Woodward's well chosen term *Eoanthropus*, made highly intelligent use of his 1240 1300 cubic brain measurement

This brings us to the most startling discovery of the twentieth century, the full significance of which we have only recently learned to estimate

THE FIRST POSITIVE DISCOVERIES OF TERTIARY MAN

Archæologists are still divided as to the human origin of *eoliths*, so that we cannot class these rude flints as positive evidence

One of the most striking coincidences in the history of human palæontology is that indubitable flint implements of Tertiary man were discovered by J Reid Moir on the east coast of Anglia in the year 1909, and that in 1911 only two years later, an indubitable human skull and jaw of what proves to be Tertiary man were found in Piltdown, Sussex, by Charles Dawson It has required eighteen years of research by Moir and Smith Woodward, aided by the most able archæologists and anatomists of the world to establish the full significance of these epoch making discoveries of 1909–11 By adding year by year implement after implement from two strata of Upper Pliocene time, J Reid Moir, originally an amateur collector of Ipswich, has finally overcome all incredulity and even hostility and has thoroughly established the Red Crag and sub Red Crag strata of the Upper Pliocene coast of Anglia as the site of a widespread and highly varied flint and bone industry, including the 'eagle's beak' (rostro carinate), 'skin cutter', 'side scraper', 'push plane', 'borer' and 'chopper' and 'piercing tool', all indicating a race of hunters highly adept at flint flaking, finally, for killing purposes, a perfected 'sling stone', ranking as a work of Palæolithic art

All of these artefacts have been confirmed and recently embodied in the Stone Age chronology of Abbé Henri Breuil (December 1929) Breuil not only accepts the Tertiary age but also in his latest paper (December 1929) shifts the entire pre Chellean and Chellean flint industries from mid Quaternary down into the base of Quaternary time, namely, into the first Interglacial or Mindel Riss stage, this obviously shifts the pre Chellean and Chellean flint making design and intelligence down close to Tertiary time—in fact, some of Reid Moir's flints are identical with the Chellean artefacts

Meanwhile Osborn, by world wide study of fossil elephants and mastodonts, has firmly established these Reid Moir flint beds as of Upper Pliocene or close of Tertiary time, against the contention of the late Ray Lankester that these flints were early Pleistocene Scarcely less positive is Osborn's determination, with the aid of Reid Moir, Freudenberg of Heidelberg, Matsumoto, and Bather and Hopwood of the British Museum, that the Piltdown race—*Eoanthropus dawsoni* of Smith Woodward—is of Upper Pliocene Tertiary age rather than of Quaternary age as formerly supposed

Both the Red Crag of Suffolk and the Piltdown beds of Sussex yield a very primitive species of elephant generally known as *Elephas planifrons* (first discovered (1858) by Falconer in the upper Siwaliks of India) the migrations of which are now traced (Broom) from the Vaal River of South Africa northward into Italy and England, far eastward into India, with absolutely definite measurement and form of the enamelled ridge plates of the grinding

teeth which in the elephants and mammoths give us ***a new and quite dependable means of dating all the fossil man discoveries of Upper Tertiary to recent time*** Upper Tertiary man is thereby shown to have been an elephant hunter, probably for bone and ivory as well as for flesh, more than a million years ago This discovery also paves the way for the great inter continental migration routes and the African Eurasian dispersal of man even in as re mote a period as the Upper Pliocene

In view of the fact now established that even in the Upper Pliocene man was an extremely adept flint worker, with deft hands and fingers guided by an imaginative and intelligent forebrain, it seems probable that Upper Pliocene man, like his companion the Upper Pliocene elephant, was already a nomad and needed long and agile lower limbs as his only means of distant transportation We are thereby forced to reconsider Darwin's concept of the primitive ape man as inhabiting a 'warm, forest clad land "

TRAVELLING LIMBS AND TOOL MAKING HANDS

Fifty eight years of incessant zoological and com parative anatomical research have been focused upon the anatomy and embryology of the apes and man to find out the bearing of the recapitulation or biogenetic principle of Haeckel on the ancestral Tertiary hands and feet of man Recently, Morton (1927), Schultze (1925-29), Straus (1927), Gregory (1925-29), Hrdlička (1928), have devoted special memoirs to this problem, Straus summing up in the paraphrased words The foot of embryonic man is of a structure unfitted for an upright terrestrial existence It is in most characters not unlike that of an adult gorilla, although in some respects even more primitive than that of the largest anthropoid apes The chief point of embryonic resemblance is in what Darwin termed 'the prehensile big toe', but the palæontologist Matthew (1928) has pointed out that all primitive Eocene mammals, both arboreal and terrestrial, had the big toe well set apart from the others This stronghold of 'pre hensile big toe' evidence, therefore, carries man far back of the highly specialised anthropoid ape big toe stage and tends to sustain the 'dawn man' contention that even the embryonic foot of man may date back to the more remote Upper Eocene time

This contention is even more strongly borne out by the embryonic human hand, in which there is no evidence whatever of having passed an anthropoid ape limb-grasping stage While the newest analysis of the embryonic hind limbs may leave us in doubt as to a possible case of reversed evolution from the Miocene ape leg to the human stage, the human hand and the human brain, especially in the light of *Eoanthropus* discoveries, seem to dissipate some of the doubts raised by the feet and strengthen the new 'dawn man' hypothesis of a very remote separation of our running and tool making ancestors of the plateaux and savannas from the same great stock (Anthropoidea) which independently gave rise to the tree-loving anthropoids of the tropics

No one should misunderstand the 'dawn man' hypothesis I have been advocating in a series of papers and addresses since April 7, 1927 I am not ignoring the strong evidence for an Eocene arboreal stage in our ancestry, I am not ignoring the overwhelming evidence of a remote community origin between man and the anthropoid apes, I am combating the special feature of the Lamarck Darwin hypothesis that man once passed into highly specialised arboreal adaptations attained by the Miocene apes, finally, I am inclined to separate the human stock at a geologically earlier pre-Miocene period of anthropoid evolution In the geological remoteness of this momentous separation of the 'dawn man' stock, we are aided by a mass of collateral evidence utterly unknown in the time of Darwin

This brings us back to the sub science of phylogeny spoken of above, which, in popular terms, aims at the reconstruction of the family tree of man by principles recently discovered in the family trees of other mammals

NEW PRINCIPLES OF PHYLOGENY APPLIED TO MAN

First, we have discovered that the geological period of separation of the adaptively radiating branches in many families of mammals is of an antiquity undreamt of even a few decades ago Even in Lower Eocene time, all the existing families of hoofed mammals, such as the horses, tapirs, rhinoceroses and titanotheres, had widely separated from each other in tooth, limb, hand, and foot structure Before the close of Eocene time, these branches were further subdivided into forest loving and plateau loving types, in every branch the forest-loving types were stationary or regressive Similarly, by the close of Eocene time the mastodont and elephant families are found widely separated into five greater branches (in Oligocene time there were numerous sub branches and in Miocene time eighteen distinct branches) In the succeeding Oligocene time, we discover a sharp and world wide division between plateau loving and forest loving types, in the forests remain all the backward conservative types, on the plateaux and uplands are found the alert progressive forward looking types, including all the long hind limbed bipedal animals adapted to rapid progression in an open or partly forested country It is no exaggeration to say that at the dawn of Oligocene time all the plateau loving animals are distinctly modernised both in habits and in bodily proportions

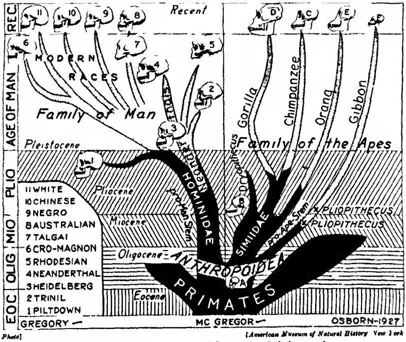
Is it likely that the primates alone escaped this divorce between backward, forest loving life and forward, plateau, savanna and upland life, especially as Eocene forest areas in every continent began to contract and upland open plains and plateaux began to expand ?

A second principle of modern phylogeny is that every ancestral stage, whether of horse, rhinoceros, or elephant (the three kinds of animals I have most intensively studied for the past thirty years), preserves the hundred per cent *structural equipment* for giving rise to its more recent or modernised descendants, each branch has the potentiality of the remotest twigs of descent Through change of function Nature may transform an organ, but it

can never restore a single lost part, whether it be a lost tooth, a lost digit, a lost ankle bone or rib, a lost tendon or nerve. This is Dollo's principle that *the evolution of anatomical organs is never reversible even though the evolution of functions and habits is frequently reversible*. On this principle the human hand could never reacquire the nerves, muscles, functions, freedom, flexibility, and separate innervation lost in the highly specialised arboreal ape hand; the opposable human thumb could not spring back from the partly atrophied anthropoid ape thumb. Our quadrupedal ancestors certainly had a forefoot capable of developing into the human hand with its long flexible fingers separately innervated and its thumb which, as Erasmus Darwin postulated, could reach the tip of each finger in turn, all depending upon separate innervation from special cell centres in the spinal cord and brain. Primitive man is not only a tool making animal, he is also a music making animal; consider 'Blind Tom', the negro musical genius of his day, who not only possessed an excellent finger technique but also a marvellous musical memory that enabled him after a single hearing to repeat elaborate piano compositions. In this human hand connexion let us recall also the researches of Sir Richard Paget in advocating the gesture origin of human speech, as gesture demands flexible fingers.

Third, to this hundred per cent structural equipment of our remote ancestors phylogeny adds a hitherto unperceived germinal potentiality of specialisation along certain predetermined directions rather than others in adaptive reactions to changes of environment; this *teleogenesis* rests upon thousands of observations among primates, horses, titanotheres, and elephants which prove that parallel anatomical and psychical progress is traceable to germinal community of origin. The psychic resemblances of the apes to man are partly parallelisms, partly common inheritance (Yerkes). Teleogenesis is not to be confused either with the old 'teleology' nor is it a revival of a hypothetical vitalism or internal perfecting tendency.

Finally, and perhaps from glandular impulses (Keith), phylogeny proves that independent of selection, of environment, of habit, certain phyla exhibit rapid or accelerated physical and mental adaptation, while others are held back. The creative brain, the tool making hand, the fleet hind limb of man apparently combine in accelerated adaptation, while forest loving primates advance much more slowly.



Photo] [American Museum of Natural History, New York.

FIG 2. Osborn's present theory of the ascent and phylogeny of man.

Left: Family of man (Hominidæ), dividing into the Neanderthaloid and modern racial stocks; present geological location of the Piltdown, Heidelberg, Trinil, Neanderthal, and Rhodesian fossil races. Right: Family of the apes (Simiidæ), including the Pliocene and Miocene dryopithecoids nearest the ancestral stock of the Anthropoidea; also the lines leading to the gorilla, orang, chimpanzee, and gibbon. Below: Anthropoidea, the common Oligocene ancestors of the Hominidæ and of the Simiidæ.

Does not this unbiased survey of recent discoveries in archæology, human and comparative palæontology, human and comparative anatomy, compel us to reconsider the classic Darwin Lamarck hypothesis and to substitute a new hypothesis? The new hypothesis carries us into a geological antiquity hitherto undreamt of. Anthropology is forced to share with chemistry and physics entirely new notions of space and time. To my mind, the human brain is the most marvellous and mysterious object in the whole universe, and no geological period seems too long to allow for its natural evolution.

The Tannic Acid Treatment of Burns

BURNS or scalds of relatively small areas of the body frequently have a fatal ending, especially in children, so that any method of treatment which will reduce this mortality requires careful examination and adoption if proved successful In 1925, E C Davidson described a method of treatment by means of tannic acid which he had found reduced the mortality from these injuries, and the treatment has been put to a critical test by W C Wilson in the wards of the Royal Edinburgh Hospital for Sick Children and the Royal Infirmary, Edinburgh, with the result that the mortality has been reduced to little more than a quarter of that observed in another comparable series of cases [1]

The course of events following a burn may be divided into four fairly well-defined stages The first is the stage of reaction to the immediate effects of the injury or stage of initial shock, its clinical features are prostration, low temperature and blood pressure, a small rapid pulse and cold skin It is of nervous origin and is most often only slight in degree After it has passed off the patient appears well for a time, but after about 12 24 hours acute toxæmia or secondary shock appears and may be quickly fatal The chief features of this stage are similar to those of the initial shock, but rapid shallow respiration, vomiting, restlessness, and anxiety, changing to coma, may also be observed, and the temperature is frequently considerably elevated The condition is similar to the secondary shock developing in severely wounded patients, which was proved by experiments carried out during the War to be due to the absorption into the circulation of toxins set free in severely damaged tissues, especially muscle

The work of Dale and his collaborators showed that typical secondary shock was produced by the intravenous injection of such a vasodilator as histamine, and that the vasodilator effects of tissue extracts could be matched by the injection of histamine and cholinc together The isolation of histamine from muscle by W V Thorpe (*Biochem Jour*, vol 22, p 94, 1928) was the final confirmation of these experiments, whilst the work of Lewis and his collaborators showed that the responses of the skin of man to injury and to the injection of minute doses of histamine were identical It may be considered as certain that secondary shock is due to the absorption into the blood stream of some substance which is formed at the injured area itself, Wilson suggests that it is probably a product of protein lysis, it may quite possibly be histamine itself

The third stage is that of septic toxæmia and is only well developed clinically when there is severe infection of the injured area The fourth and final stage is that of healing, and its duration depends largely on the depth of the lesion First and second degree burns heal quickly and without the formation of scar tissue, in the third degree lesions the surface becomes covered with granulations over which the epithelium grows, leaving a supple and greyish white scar in deeper burns, or where sepsis has been a prominent feature, scar tissue development is more marked, and owing to its subsequent contraction, deformities and disabilities may follow

Each of the four clinical stages requires its own treatment For a slight degree of primary shock no special treatment is necessary, but where it is severe, morphine should be given, artificial heat applied, and fluids administered Local treatment is begun at the same time and involves cleansing and dressing of the injured area To prevent secondary shock it is necessary to prevent the absorption of the products of tissue breakdown the only methods which have been at all successful have been excision of the burned area and coagulation of the damaged tissue by tannic acid In the third stage the condition is that of a septic wound and fomentations and antiseptic dressings will be necessary, whilst during the healing stage special measures may be required to prevent contraction

Wilson gives a full description of the method of treatment by tannic acid, and includes in an appendix a description of its use in the first aid treatment of burns In hospital the burned area is first cleansed with ether under general anæsthesia, either gas or oxygen (if shock is marked) or ether being administered The area is then sprayed with a warm sterile 2 5 per cent aqueous solution of tannic acid, freshly prepared, and the parts dried in hot air under a bed cage The spraying is repeated hourly until the area is covered with a firm brown layer of coagulated tissue 8 12 applications may be necessary in burns of the second and third degrees No dressings are required if the whole of the injured area cannot be exposed to the air, compresses of tannic acid are applied to the parts on which the patient lies In most cases the coagulum is left until it peels off, leaving either a healed area or healthy granulations according to the depth of the burn In no circumstances should a moist dressing be applied, since this procedure results in the appearance of toxic signs and symptoms

In this study 117 children were treated by the tannic acid method between November 1925 and January 1929 The mortality was 11 1 per cent, or in 105 children under ten years of age 10 5 per cent In 300 cases under ten years treated by other methods, the mortality was 38 7 per cent The percentage distribution of the mortality over the first three stages was, in the present series, 30 8, 23 8, and 23 8, and in the previous series 2 5, 80, and 15 respectively Thus the tannic acid method of treatment controls the acute toxæmia of the second stage, and by reducing the mortality due to it, brings into greater prominence the fatalities which occur at other stages and in some instances these deaths were not directly connected with the injury

Besides reducing mortality, the treatment lessens

[1] "The Tannic Acid Treatment of Burns", by W C Wilson Medical Research Council, Special Report Series, No 141 Pp 34 (London H.M Stationery Office, 1929) 1s net

the severity of the symptoms at all stages and promotes rapid healing at the same time it permits of the recovery of patients with involvement of a considerable area of the body surface Previously it was considered that burns of 30 per cent of the body surface in an adult and of 11 12 per cent in a child were almost certain to prove fatal From the results obtained in this series of cases it may be concluded that involvement of more than 60 per cent of the surface in children will cause death from shock in a few hours when between 35 and 60 per cent of the surface is affected, the outcome depends mainly on the degree of sepsis which develops and therefore on the depth of the lesion With less than 35 per cent of the surface involved the prognosis is good, provided treatment is begun within a few hours of injury

The results of this method of treatment have been so successful in the hands of Davidson and Wilson that it is to be hoped that many other clinicians will try it out and find it equally satisfactory

Obituary

SIR HENRY JACKSON, G C B, K C V O, F R S

THE death of Admiral of the Fleet Sir Henry Jackson on Dec 14 has caused deep regret in both naval and scientific circles His courtesy his charm of manner, his unswerving devotion to duty, and the sweet simplicity of his nature endeared him in an extraordinary degree to all with whom he came into contact The recollection of their association with him will be a treasured memory to many throughout their lives

Henry Bradwardine Jackson was born at Barnsley in 1855 and entered the Navy in December 1866 During 1878 and 1879 he served on the African station and took part in the Zulu War On returning to England he was appointed to the *Vernon*, where he qualified as a torpedo lieutenant and remained there three and a half years About this time he was sent by the Admiralty to study torpedo design and construction at the Whitehead establishment at Fiume

In 1891 the Navy was seeking some means by which a torpedo boat could announce her approach to a friendly ship, and the idea first came to Sir Henry Jackson of employing Hertzian waves as a means of communication for this purpose He was then at sea and was unable to put his ideas into a practical form until in 1895, when in command of the *Defiance*, he read of some experiments by Dr (now Sir Jagadis) Bose on coherers Having obtained a satisfactory coherer, he managed in this year to effect communication by electromagnetic radiation from one end of his ship to the other During the next two years he continued his experiments with increasing success On Sept 1, 1896, he first met Mr Marconi, and the two pioneers of radio-telegraphy kept in close touch and gave each other much mutual assistance until Sir Henry Jackson was appointed Naval Attaché in Paris early in 1897

In 1899 Sir Henry Jackson was appointed to command the *Vulcan*, and in 1900 wireless telegraphy received definite recognition in the Navy, a contract being placed with the Marconi Company for the supply of installations to a number of His Majesty's ships The new means of communication was employed with considerable success in naval manoeuvres in that year From this time to his promotion to flag rank in 1908, Sir Henry Jackson remained generally responsible for the development of radio-telegraphy in the Navy His own researches were mainly on the lines of improving methods of tuning and the study of the effects of land screening the interference of atmospherics, and the influence of meteorological conditions on radio communications

In 1901 Sir Henry Jackson was elected a fellow of the Royal Society, and in the next year communicated to the *Proceedings* of the Society a paper entitled "On Some Phenomena affecting the Transmission of Electric Waves over the Surface of Sea and Earth" This is now a classical paper and well illustrates the careful and methodical manner in which Sir Henry Jackson always made and recorded his observations In modern radio research, in particular on wave propagation, much attention is given to the results of the mutual interference of several waves arriving at a point with various phase differences In this connexion it is interesting to note that Sir Henry Jackson observed the zones of weak signals, for he wrote " This phenomenon manifests itself by the gradual weakening and occasionally by the total cessation of signals, as the distance of two ships increases, up to a certain point, and their reappearance as the distance is further increased " He went on to say that he considered this effect was due to want of synchronism in the oscillatory discharge between the spark balls of his transmitter, so that there was a change in frequency between the successive discharges of the transmitter This, he pointed out, would produce successive oscillations out of phase with each other which would at one point annul each other, while at a further distance they would reinforce each other

In 1905, Lord Fisher, under whom Sir Henry Jackson had served in the Mediterranean, appointed him Third Sea Lord and Controller In this post his scientific qualifications made him specially suited to take charge of the application of science to the practical work of the Fleet at a time when the design and equipment of warships were undergoing rapid development and improvement

At the beginning of the War, Sir Henry Jackson was retained at the Admiralty, working in conjunction with the War Staff, and was appointed First Sea Lord on May 23, 1915, when Lord Fisher left the Admiralty He held this high office until December 1916 During this period he worked in complete harmony with Lord Jellicoe, and the foundations were laid for various schemes for fighting the submarine menace, including the raid

on Zeebrugge, which were to be brought to fruition later During Sir Henry Jackson's period of service as First Sea Lord the Battle of Jutland was fought In this connexion it is interesting to notice the faith he always had in wireless methods During the discussion at the Institution of Electrical Engineers of a paper by Capt Round on radio direction finding, he revealed that the evidence which finally convinced him that the German High Sea Fleet was really coming out was the observation made by a radio direction finding station of a change of bearing of 5° in the position of a German battleship

After rendering invaluable service to the nation, Sir Henry Jackson was promoted Admiral of the Fleet in 1916 From April 1917 to July 1919 he had the honour of serving as First and Principal Aide de Camp to the King He retired from the Navy in July 1924

In 1920 the Lord President of the Council appointed Sir Henry Jackson as the first chairman of the Radio Research Board of the Department of Scientific and Industrial Research At the time of the formation of the Board the rapid development of radio communications had caused technical application to outstrip fundamental knowledge of the subject The taking up once more of the scientific aspects of radio-telegraphy was a task which was completely congenial to Sir Henry Jackson Under his guidance, more than one hundred important papers have been published dealing with such subjects as the propagation of waves, the nature and origin of atmospherics, radio direction finding, and the measurement of electrical quantities at high frequencies It is characteristic of him that although he gave his personal attention to the work described, yet he never desired to claim personal scientific credit for any of the results obtained His helpful and kindly criticism, and his generous spirit, had the inevitable result of creating feelings of the utmost devotion in the staff whose work he supervised In 1926 the Royal Society awarded him the Hughes medal in recognition of the high merit of his work This honour gave him very great gratification

In addition to supervising the work of the Radio Research Board, Sir Henry Jackson did much private experimenting With apparatus of his own design and manufacture he carried out pioneer work on the reception of short waves Some of his most striking results in this connexion were referred to by him in a contribution to a discussion arranged by the Royal Society on the electrical state of the upper atmosphere

Sir Henry Jackson was secretary, and later chairman, of the British National Committee on Radio-Telegraphy formed a few years ago under the auspices of the Royal Society, in connexion with the International Union for Scientific Radio-Telegraphy His contributions to the meetings of the general assemblies of the Union had the result of placing British prestige in the scientific aspects of radio telegraphy on a very high level

In 1890 Sir Henry Jackson married Alice, daughter of Mr S H Burbury, F R S The Burbury family were also pioneers in radio telegraphy, and many early experiments were carried out by them and Sir Henry Jackson in the grounds of their house in Yorkshire

Sir Henry Jackson was a member of the Institution of Electrical Engineers, honorary vice-president of the Institution of Naval Architects, honorary D Sc of the Universities of Oxford and Leeds, honorary LL D of the University of Cambridge, and vice president of the Seamen's Hospital Society He was created K C V O in 1906, K C B in 1910, and G C B in 1916 on his retirement from the post of First Sea Lord

Mr P H Hepburn

Patrick Henry Hepburn was born in 1873 and educated at Charterhouse and at Amersham Hall School near Reading He obtained a First Class Honours for the London LL B degree and followed his father's profession as a solicitor He was a man of many interests In 1902 he made a large collection of photographs of Norman churches round Caen to test a theory that the Gothic cross vault was a development of the Angevin dome Before the War he was fond of boating and swimming, and bicycled all over England and Scotland and large parts of France and Belgium Until recently he frequently bathed in the middle of winter in the Serpentine He would take lonely walks over mountains and fells at night, and only two years ago was found in an exhausted condition and taken to a neighbouring inn This pursuit led to the accident which caused his death Walking by night in the Lake district, he fell into a river and apparently struck his head on a rock and was drowned During the War his adventurous spirit led him to join the balloon section of the Naval Air Service An exciting incident occurred on one occasion Going up at Richmond to a 'blimp' stationary balloon with a mechanic to make some repairs, they were caught by a line squall and the balloon was torn from its moorings and turned completely over The occupants managed to hold on, the balloon righted itself and came down safely in Suffolk He served in East Africa, where he was disappointed in not being able to climb Kilimanjaro, and afterwards in the Mediterranean In Gibraltar he was a friend of the padre and used his library to learn Hebrew

Mr Hepburn's interest in astronomy began in the early 'nineties with the purchase of a 3 inch telescope He was interested in eclipses and went to Vadso in 1896, to Spain in 1900 and 1905, and to Normandy in 1912 In 1914 he went with the Greenwich observers, Dr Jones and Mr Davidson, to Minsk He was a great help to them in all ways, especially as, owing to the outbreak of war while the observers were in Russia, they were deprived of other assistance which had been promised In 1927 he observed the eclipse with Dr Merton from an aeroplane

Mr Hepburn took charge of the Observatory of the Hampstead Scientific Society at its opening in

1910 and showed Halley's Comet to many people He was always helpful to amateur astronomers and never spared time or trouble when he could assist them He joined the British Astronomical Association in 1896, and took an active part in the meetings from 1912 onwards, contributing numerous papers He served on the council for many years and was director of the Saturn Section He was president in the years 1921–2 and 1922–3, giving addresses on "The Masses, Densities, and Surface Brilliancies of Stars", and a brief summary of the history and recent developments of astronomy He was on the Council of the Royal Astronomical Society and treasurer for the year 1927 In 1911 he purchased a 13 inch reflector and made numerous observations of the surface features and rotation of Saturn He was a most energetic observer, and when a larger telescope than his own was required would come on Sunday nights to Greenwich and use the 28 inch refractor, for which he was well qualified by his remarkably keen sight He would sometimes sit up the whole night, and go to his office in the morning and do his regular day's work, apparently without feeling any effects He was extremely modest about his astronomical work He had a large circle of friends among astronomers, who are deeply grieved by his sudden death, and wish to convey to his widow and children their respectful sympathy F W D

WE regret to announce the following deaths

Dr R Wilfred Balcom, chemist in charge of food control of the Food, Drug, and Insecticide Administration of the U S Department of Agriculture, on Oct 17, aged fifty one years

Prof Ludovico Marini, professor of terrestrial physics in the Universities of Rome and Naples and author of many papers on the climatology of the Mediterranean, on Oct 6

Dr Jan Metzelaar, of the University of Michigan Museum and fisheries expert of the Michigan State Department of Conservation, on Oct 4, aged thirty seven years

Prof P J White, professor of zoology in the University College of North Wales, Bangor, and director of the Puffin Island Biological Station, on Dec 26, aged sixty seven years

News and Views.

ONE of the realisations which have crept into the biological thought of the last decade is that the starting points of the main groups of animals are far more remote in time than had been supposed, and what is true for the great phyla would seem also to be true for many lesser stocks Since the ancestral forms of present day families of hoofed mammals had already attained the characteristic specialisations of their kind in Lower Eocene times, how much more remote must have been the critical point where the common history of the ungulates began Struck by this and other recent discoveries in the principles of phylogeny, Prof Henry Fairfield Osborn has re examined the story of the origin of man in the new light, and has summarised his conclusions in an address delivered at the close of the year to the American Association for the Advancement of Science, under the title, "The Discovery of Tertiary Man" The address, which appears elsewhere in this issue of NATURE (p 53), will be welcomed, since it clearly defines Prof Osborn's position, and must remove the misconceptions to which some of his pronouncements have given rise amongst those anxious to regard every scientific dispute as a nail driven into the coffin of man as a product of evolution He states his case in a nut shell "No one should misunderstand the 'dawn man' hypothesis I have been advocating in a series of papers and addresses since April 7, 1927 I am not ignoring the strong evidence for an Eocene arboreal stage in our ancestry, I am not ignoring the overwhelming evidence of a remote community origin between man and the anthropoid apes, I am combating the special feature of the Lamarck Darwin hypothesis that man once passed into highly specialised arboreal adaptations attained by the Miocene apes, finally, I am inclined to separate the human stock at a geologically earlier pre Miocene period of anthropoid evolution"

THE study of prehistoric man himself, thanks to many discoveries, has made great strides in recent years Fossil remains of more than a hundred Quaternary individuals have now been found, and they show indubitably that in size of brain (apart from the arrested development of the Trinil man of Java) Quaternary man equalled or exceeded modern races of mankind The suggestion clearly is that the early development of the brain of modern man must be looked for in deposits earlier than Quaternary Prof Osborn traces the evidences which point to the existence of Tertiary man, the presence of artefacts in the Upper Pliocene strata of the Red Crag and sub Red Crag, the actual discovery of the Piltdown man, whose association with *Elephas planifrons* indicates his Upper Tertiary origin, and the indirect evidence of the embryonic structures of foot and hand, which carry man far back beyond the specialised anthropoid apes of the present day Prof Osborn is almost overwhelmed by the results of his consideration, for he concludes "To my mind, the human brain is the most marvellous and mysterious object in the whole universe, and no geological period seems too long to allow for its natural evolution" The real conclusion is, not that infinite time must be postulated, but that we have still much to learn about the processes of natural evolution However that may be, we can agree with Prof Osborn that as the discovery of Quaternary man was the central biological achievement of the nineteenth century, so the running down of his Tertiary forbears is likely to be a triumph of the twentieth

DURING 1928 abundant evidence that orang utans were being captured and exported on an unprecedented scale from Sumatra, one of their two island strongholds, aroused concern lest this interesting and

scarce anthropoid ape should be exterminated The capture was illegal, for already in 1924 and 1925 the Government of the Netherlands East Indies had declared it to be a punishable offence to hunt, catch, kill, or to possess or to keep, either dead or alive, the orang utan within the whole area of the colony But the law was difficult to enforce, especially in face of the demand abroad for living specimens and the large prices which were being offered The wholesale exports of 1928, however, brought the matter to a climax, and widespread protest was made by naturalists and scientific societies in Great Britain against the obnoxious trade We are pleased to be able to report that the agitation on behalf of the orang has had a successful issue From the *Times* of Dec 31 last we learn that Lord Passfield, Secretary of State for the Colonies, in reply to a dispatch sent from Sir Hugh Clifford before he left Singapore, has approved the introduction of legislation to prohibit the importation of orangs into the Straits Settlements and the Federated Malay States The question was taken up at the request of the Netherland Indian Government, and Sir Hugh Clifford and his executive council agreed that British Malaya might properly co operate with the Government of the Netherlands East Indies to prevent the extinction of the species Now that the approval of the Colonial Office has been given, a Bill will speedily be introduced to make the agreement effective

THE New Year honours list contains the names of the following men of science and others associated with scientific work —*Baronets* Sir Gregory Foster, who has just retired from the post of Provost of University College, London, and was recently Vice Chancellor of the University, Sir Eustace Tennyson D'Eyncourt, at one time Director of Naval Construction, Admiralty *K C M G* Lieut Col Andrew Balfour, member of the Colonial Advisory Medical and Sanitary Committee and Director of the London School of Hygiene and Tropical Medicine *Knights* Prof. T P Nunn, Principal of the London Day Training College, and professor of education in the University of London, Mr Archibald Page, Chief Engineer and Manager of the Central Electricity Board and a past president of the Institute of Electrical Engineers, Mr Alexander Rodger, Inspector General of Forests, Government of India, Prof T Zammit, Curator of the Museum, Malta *C I E* Mr B C Burt, Imperial Council of Agricultural Research, India, Mr. H L Newman, Chief Conservator of Forests, Bombay, Mr S Walker, Chief Engineer and Secretary for Irrigation, North West Frontier Province, India. *C B E* Prof. J S S Brame, professor of chemistry and metallurgy, Royal Naval College, Greenwich, Mr G E S Cubitt, lately Conservator of Forests, Straits Settlements and Federated Malay States, Capt A T A Dobson, Assistant Secretary, Ministry of Agriculture and Fisheries *O B E* Mr Joseph Jones, formerly Curator of the Botanic Gardens, Dominica, Mr W A. S Lamborn, medical entomologist, Nyasaland Protectorate, Capt R N Liptrot, principal technical officer, Air Ministry, Mr W R Mustoe, Superintendent of Horticultural Operations, Delhi, Dr E S Russell, Director of Fishery Investigations, Ministry of Agriculture and Fisheries *M B E* Mr John Aikman, Assistant, Royal Botanic Gardens, Kew, Mr E A Bearder, technical adviser, Dyestuffs Advisory Licensing Committee, Mr A A Gomme, Librarian, Patent Office, Board of Trade

THE French Society of Chemical Industry holds its annual meetings alternately in France and a foreign country, since foreign participants are invited, the meetings rank as congresses Last year's meeting, held at Barcelona in October, was attended by some 270 French and 400 Spanish chemists, and altogether about 17 foreign countries were represented The opening address was delivered by Prof H E Armstrong under the title "Structure moléculaire La vie et la couleur Pensées allégoriques d un chimiste en Espagne" In a recent issue of the *Journal of the Society of Chemical Industry* (Dec 13, 1929, p 1198) Prof Armstrong records some interesting 'after thoughts' on the congress For example, in the course of a journey across Andalusia, from Seville to Granada and back to Cordova, he was impressed by the innumerable rows of olive trees covering the hills "The labour entailed in plucking the fruit must be enormous —the industry can only be possible in a country where the cost of living is very low Travelling hour by hour through such country, the chemist, if taking notice, can but wonder how so modest looking a tree does the trick of making oil Heaven save us, however, from ever manufacturing the oil synthetically and so destroying the peace of mind and rational occupation of multitudes of happy beings engaged upon healthful work consonant with their intelligence Our modern lust to manufacture must be curbed"

A VISIT to the cathedral at Burgos was the immediate cause of a train of reflections which Prof Armstrong expands under the text "We too must build our Cathedrals with utmost magnificence and make them full of clear meaning" He regards it as the province of the man of science to proclaim the infinite wonder and glory of the cosmos and to provide for humanity a living soul, rather than to follow the cult of the world, the flesh, and the devil "Saints enough we already have to range in effigy behind many altars—the story of whose wondrous deeds and prophetic powers may well be told in ways to evoke interest and thankfulness even in the masses Why should we not have our Columbus, our Darwin, our Liebig, our Pasteur, our Volta day? A full calendar of saints who have rendered worshipful service to mankind and set worthy example? Decorative work would be found for artists in every direction a new era would arise from our action, music would flourish and all the arts Unless and until science become thus militant, we shall be little more than slaves of society, mere mechanics Unless scientific workers take constructive action, there will be little or no moral progress, nay, worse, our civilisation may go under There is grave danger that the Churches of to day may lapse into the hands of the ignorant, as knowledge spreads and the more intelligent can no longer follow their doctrines" Like Kekulé, the doyen of British chemistry has learnt to

dream, and his waking thoughts, always interesting, are often provocative. The views upon synthesis, religion, and other matters which he unfolds in this contribution will perhaps be held by the orthodox to bear the taint of heresy; nevertheless, they are bound to meet with a good deal of general sympathy and to stimulate thought and discussion.

THE Empire Marketing Board has appointed a Committee to advise on the "Infestation of Stored Products by Insects and Fungi", of which the membership is as follows: Mr. E. M. H. Lloyd (chairman), Mr. H. Brown, Dr. E. J. Butler, Dr. P. A. Buxton, Mr. J. C. F. Fryer, Mr. F. Laing, Mr. T. W. Macara, Dr. J. W. Munro, Dr. J. G. Myers, Mr. H. C. Sampson, Prof. V. H. Blackman, Mr. W. S. Thomson (secretary). By a series of grants made to the Imperial College of Science and Technology, the Board has enabled the College to establish at Slough a station for the conduct of research on the infestation of stored products. This work is under the direction of Dr. J. W. Munro, assistant professor of entomology in the College, and has been planned along lines similar to those laid down in the Tenth Report of the Royal Society (War) Committee on Grain Pests for the continuance of the work on grain pests which it had begun, but which terminated shortly after the conclusion of the War. Thus, the work is considered as comprising three main activities: survey or intelligence work, biological and mycological research, and the application of research results to the control of insects and moulds. The survey or intelligence work is carried out mainly at the London docks, with occasional work at Bristol and Liverpool. The biological and chemical research work is carried out at the Biological Field Station at Slough, but the application of results to practice has not yet been carried out except on a small scale because, as is obvious, successful application requires fuller knowledge than can be obtained in the short space of time during which work has been in progress. For the present, the research in progress is concentrated on cacao, copra, and dried fruits, but other products are also receiving attention, and the whole field of stored products in entomology and mycology will be explored as time and opportunity permit.

SIR HUBERT WILKINS has made further discoveries in Antarctica to the south of Graham Land. In a recent dispatch to the *Times*, he describes how he launched his aeroplane from the research vessel, *William Scoresby*, to the west of South Graham Land. The first attempt on Dec. 28 was a failure owing to a heavy snowfall obscuring visibility and necessitating a return. Three days later a start was made from the ship at the edge of the pack ice 115 miles from the nearest land. The exact location is not given. Charcot Land was found to be an island, as was expected, and the monoplane continued to the westward along Hearst Land, charting a new stretch of the coastline of Antarctica for about three hundred miles. A later dispatch from the expedition records a severe earthquake at Deception Island on Jan. 3. The aeroplanes of the expedition escaped damage.

CONSIDERABLE progress has been made with electrical heating during recent years, although the cost of electrical energy is higher than the cost of solid and liquid fuels. In many cases the advantages of cleanliness, convenience, and efficiency more than outweigh the increased cost. Some of the London supply companies charge only a halfpenny per unit when the supply is used purely for heating or power. This charge could be considerably reduced if the limitation that the supply must be continuous were removed. Continuous availability necessitates that any such supply must bear its proper proportion of the overhead charges of the power system. If this supply were confined to the 'off peak' hours only, the load on the station would be more constant and an appreciable reduction in the price could be made. In a paper read to the Institution of Electrical Engineers on Dec. 19 on the heating of buildings electrically by means of thermal storage, Colonel Monkhouse and Mr. L. C. Grant described practical installations where this method has been adopted. Water contained in tanks suitably lagged so as to have high thermal insulation is heated during the 'off peak' hours, which are usually a few hours on either side of midnight, and the heat is retained for use until the next heating period comes. They laid stress on the fact that buildings which are to be heated in this way can be built without flues or smoke stacks. Figures were given showing the saving this effects in capital costs in certain cases. At Carliol House in Newcastle, the estimated annual cost for heating by coke in a normal winter was £1882, and for heating electrically it was £1904. In the latter case a saving on the capital cost of £2000 could have been effected by having no chimneys. This is not taken into account in the estimate, neither is the fact that the capital cost of the electrical installation is very high owing to the duplication of all the plant.

THE design of pendants and fittings for lighting rooms is gradually undergoing a change. The general public are becoming accustomed to the new systems which are exemplified in modern kinematograph practice and in stage decoration. A. B. Read, in the *Electrician* for Dec. 27, points out that tubular forms of lighting have developed from the use of tubular and 'striplite' lamps. The greatest use has been made of this system of lighting in Germany, where fittings of one tube, long lines of tube and groupings of tubular shapes have been employed with conspicuous success. Double ended 'striplite' lamps of large diameter are common in Germany. They can be mounted cheaply and produce a pleasing effect. In the old days, electric light fittings were often made to resemble a flower; now more simple and direct designs are used. In modern life, rooms are not decorated to last as long as a life time. It would be advantageous to devote some of the money expended on redecoration to obtain effective decorative lighting. Lighting from large surfaces and panels has been used fairly extensively recently, but a good deal of the interest of the lighting is lost by not having a fitting as a definite source of light. Indirect lighting often fails to produce the pleasure that a well designed fitting does. A well designed modern fitting consists of

four vertical tubes of light with a black mirror centre tube Another consists of three cylinders of glass, the metal-work being practically concealed

IN the next century commentators will scarcely fail to remark on the fact that in the nineteenth and twentieth centuries, cultivated and intelligent people remained apathetic towards the pollution of the atmosphere by smoke They will note the display of resistance, active and passive, towards this hygenic reform, characteristic of slum dwellers, yet exhibited by even the most refined who would never tolerate the least defect in sanitation, public and domestic That reform is in train can scarcely be denied, and one sign is the appearance of a quarterly periodical, *Clean Air*, issued by the National Smoke Abatement Society, 25 King Street, Manchester, for an annual subscription of 2s 6d This reveals the existence of a body of opinion interested in a wide range of activities The first number brings to notice various technical aspects of the question, the use of gas, electricity, smokeless fuels, and smoke reducing accessories to plant A section reporting activities in the municipalities brings to light differences in the stages of advancement of public opinion Some have already in being regional smoke abatement committees, while some of these are in process of formation In the West Riding of Yorkshire such a committee is setting up a scheme of training for stokers and an examination board for their certification The advantages of bringing these activities into a common focus is undeniable

THE Society for Experimental Biology held a conference at the new building of the London School of Hygiene and Tropical Medicine on Dec 20 and 21, 1929 A number of interesting papers were read, including studies on reflex movements in the scallop, by Dr A D Ritchie, the production of formaldehyde during photosynthesis, by Dr M C Pratt, the action of acriflavine on the Protozoan *Bodo caudatus*, by Dr Muriel Robertson, differentiation and growth of the skeleton of the rabbit, by Dr A B Appleton, histological methods for exploring the distribution of biological activity in the anterior pituitary, by Dr E A Spaul, a new hormone from the anterior pituitary, by Dr B P Wiesner, fertilisation and segmentation of rabbit eggs *in vitro*, by Dr G Pincus, the physiology of colour change in Crustacea, by Miss E M Stephenson, and the biology of the parasite *Tylenchus dipsaci*, by Dr G Fox Wilson In the second session a number of excellent exhibits were given, including demonstrations of methods devised for various experimental researches in progress at the London School of Hygiene and Tropical Medicine

AN ingenious device for a self operating meteorological observatory was briefly described by Dr F Nansen at a recent meeting of the International Society for the Exploration of the Arctic Regions by means of Aircraft According to a report that appeared in the Copenhagen newspaper *Politiken*, the Meltchaneff apparatus consists of a small balloon to which are attached thermometer, hygrometer, and barometer constructed of very light materials These instruments record by means of small short wave transmitters which, with a life of about two hours automatically send out signals Records have an accuracy to within one tenth of a degree The apparatus with a weight attached will be dropped from an airship On striking the ice the weight is detached and the balloon with its instruments rises The wireless signals are received by the airship, which is thus enabled to obtain records of a vertical section of the atmosphere whenever it is desirable A further development is even more ingenious Prof Meltchaneff is at work on the details of an automatic observatory weighing $1\frac{1}{2}$ tons which is to be dropped from the airship on to the ice whence it will transmit observation three times a day and function for an entire year He suggests that an airship should be able to carry ten of these automatic observatories on a journey and place them in desirable sites on the land or pack ice An annual visit, presumably by airship, would keep them in repair

AT the meeting of the London Mathematical Society on Thursday, Feb 6, at 5 P M, at Burlington House, Mr J Hodgkinson will deliver a lecture on "Conformal Representation by Means of Lamé Functions" Members of other scientific societies who are interested are invited to attend

AT the instance of the Research Co ordination Sub Committee of the Committee of Civil Research, the Forestry Commissioners have constituted an Advisory Committee on Forestry Research The members of the Committee are as follows Mr R L Robinson (chairman), Dr E J Butler, Dr A W Hill, Dr A S Joseph, Dr Guy Marshall, Mr R S Pearson, Prof R S Troup, Prof Wright Smith, Mr W H Guillebaud (secretary)

AT each of its annual meetings, the American Association for the Advancement of Science gives a prize of 1000 dollars for the most noteworthy contribution to science made at the meeting The New York correspondent of the *Times* announces that the prize for the recent meeting at Des Moines has been awarded to Prof A J Dempster, of the University of Chicago, for a paper showing that protons have wave characteristics Prof Dempster describes some of his work in a communication which appears elsewhere in this issue of NATURE (p 51)

THE fourth General Assembly of the International Union for Geodesy and Geophysics will take place at Stockholm on Aug 15–23, all the meetings being held in the Parliament House save the inaugural meeting, on Aug 15, in the Great Hall of the Concert House The main work of the Union will be accomplished in the meetings of the separate sections, devoted to geodesy, meteorology, terrestrial magnetism and electricity, seismology, oceanography, hydrology, and vulcanology Among the important matters requiring international co operation to be considered at Stockholm will be the organisation and objects of the scheme for a new 'polar year' in 1932–33 The local committee organising the Stockholm meetings has made arrangements for various social and scientific gatherings and excursions during the period of the Assembly, and for more extended excursions, after its conclusion, to the north and south of Sweden

A SPECIAL advance overseas edition of the catalogues of the 1930 British Industries Fair, to be opened in London and Birmingham on Feb 17, is already available, and is being issued immediately to business men in Europe, North America, South Africa, and the eastern coast of South America, including all those buyers who have notified the Department of Overseas Trade of their intention of attending the Fair By this publishing feat, which has only been made possible owing to the keenness of British manufacturers to participate in the Fair, trade buyers in cities so far apart as Istambul, Cape Town, and Vancouver will be able to receive copies of the Fair catalogues before commencing their voyage to England The catalogues, apart from containing descriptive entries of the exhibits of some 1800 British manufacturers, embody a complete classification of the exhibits by trades, and indexes in nine languages

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A technical assistant and a senior technical assistant in the Admiralty Technical Pool, for the Admiralty Compass Department, Slough—The Secretary of the Admiralty (C E Branch), Whitehall, S W 1 (Jan 13) A lecturer in chemistry at the Stockport College for Further Education—The Principal, College for Further Education, Stockport (Jan 17) A senior assistant in charge at the Experimental Station of the Ministry of Transport, Harmondsworth, near Colnbrook, Middlesex—The Establishment Officer, Ministry of Transport, Whitehall Gardens, S W 1 (Jan 18) An inspector under the Ministry of Agriculture and Fisheries, for the purposes of the Diseases of Animals Act, 1894–1925—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S W 1 (Jan 20) A head of the Agricultural Department of the Seale Hayne Agricultural College—The Principal, Seale Hayne Agricultural College, Newton Abbot, Devon (Jan 20) A lecturer in dental histology in the University of Manchester—The Registrar, The University, Manchester (Jan 24) An assistant in the Library of Bedford College for Women—The Secretary, Bedford College for Women, Regent's Park, N W 1 (Feb 1) A junior assistant under the directorate of metallurgical research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S E 18 A trained attendant in the Physiology Department of University College, Cork—The President's Secretary, University College, Cork A junior professional assistant in the Meteorological Office—The Secretary (S 1), Air Ministry, Adastral House, Kingsway W C 2 A laboratory assistant under the Government of Iraq for the Health Department—The Crown Agents for the Colonies, 4 Millbank S W 1 (quoting M/1546) Junior draughtsmen at the Royal Airship Works, Cardington—The Director of Airship Development, Royal Airship Works, Cardington, Bedford Two posts for the regional organisation and development of broadcast adult education under the British Broadcasting Corporation—The Secretary, Central Council for Broadcast Adult Education, B B C, Savoy Hill, W C 2

Our Astronomical Column

Wilk's Comet—The comet is a very easy telescopic object, being visible on Jan 5 through considerable mist The following observation was obtained by Dr A C D Crommelin at Greenwich

U T	R A 1930 0	N Decl 1930 0
Jan 5^d 17^h 48^m 53^s	20^h 38^m 3 92^s	15 24′ 13 7″

The comet is keeping near the ephemeris deduced from Prof Banachiewicz's elements, the ephemeris for 18 hours U T is continued

	R A	Decl	log r	log Δ
Jan 13	21^h 19^m 45^s	N 5° 18′	9 8430	0 0679
17	21 34 51	N 1 3	9 8328	0 0990
21	21 47 33	S 3 2	9 8285	0 1289
25	21 58 0	S 6 37	9 8309	0 1557
29	22 6 55	S 9 53	9 8399	0 1797

Prof G van Biesbroeck at Yerkes Observatory observed a slender tail, 20′ in length, in a direction opposite to the sun A photograph by Dr Waterfield at Baltimore showed traces of the tail

Relation of Light Changes to Velocity Changes in Variable Stars—Mr D B McLaughlin discusses this question in *Astr Jour*, No 932 He begins by directing attention to the facts that in the Cepheid variables the light maxima nearly coincide with the minima of radial velocity, while in the Mira Ceti type the two maxima nearly coincide He has accordingly tabulated the amount of the lag of velocity minimum after light maximum, and expressed the lag as a fraction of the period of the star The results are plotted in a graph, with the logarithm of the period as abscissa and the lag ratio as ordinate The resulting points group themselves along a parabola with axis vertical and vertex on the X axis at a point corresponding to a period of a week, which is noted to be near the position of maximum frequency of the Cepheid variables

The author concludes that all the variables other than the eclipsing ones form a connected sequence, and that the Cepheid type occurs at the point of maximum stability of the pulsations of the stars, which are supposed to produce the variations of light There is one star that deviates widely from the curve, this is *RU* Camelop, the author points out that this star is peculiar in many ways, the shapes of its light and velocity curves are unusual, and its spectral class varies from K to R

Minor Planets—The issue for 1930 of 'Kleine Planeten", the annual handbook issued by the Berlin Rechen Institut, has just appeared It contains ephemerides of all the planets that pass opposition during the year, also of 433 Eros from Oct 1 to the end of the year The nearest approach of the latter does not occur until the end of January 1931, but observations will begin some time before this, it will approach the earth within some 15½ million miles, which is much the closest approach since its discovery in 1898

The planets to which permanent numbers have been assigned now extend to No 1113 It is satisfactory that several of the planets noted as new in the last two years prove to be identical with planets recorded in former years, but not previously observed sufficiently to receive numbers Many of these identifications, which involve great labour, were made by Mr B Asplind, others by L Fabry and S Beljawsky, planet 1074 has been named Beljawskya in honour of the latter

Research Items

Prehistory of the Eskimo.—In vol. 81, No. 14, of the *Smithsonian Miscellaneous Collections*, Mr. Henry B. Collins, jr., describes and figures a number of specimens of the prehistoric art of the Alaskan Eskimo and discusses their relation to the culture and distribution of the modern Eskimo. The researches of Boas and Wissler, reinforced and extended by the results of the Mathiassen First Thule Expedition (1922–24), showed that the ancient eastern culture, now known as the Thule culture, must have originated in Alaska. In 1926 the survey by Hrdlička of the Alaskan coast from Norton Sound to Point Barrow, and the archæological investigations of Jenness in the Bering Sea region, showed that underlying the existing culture of north and north western Alaska was an earlier and generally more advanced culture, marked especially by elaborately carved and ornamented objects of old ivory. This was distinct and new, though some harpoon heads corresponded with Thule types of the east. Excavations by the author on St. Lawrence and Punuk Islands, Alaska, in 1928 showed successive stages of art development of the ancient Bering Sea culture. This culture is the oldest that has yet come to light in the Eskimo north west. It differs entirely from the art of the modern Eskimo, consisting essentially of circles and lines and showing no internal evidence of ever having been associated with realistic patterns, although carved representations of animals are not lacking. Nor is there any real resemblance to the art of the north-west coast, though there is a vague general similarity which may point to a common ancestry. The finds on Punuk and St. Lawrence Islands, however, have revealed a transition stage which justifies the view that modern Alaskan Eskimo art, notwithstanding its differences and its greater simplicity, is directly descended from the old Bering Sea art. While the discovery of this ancient art, which is not primitive, has not clarified the origin of Eskimo culture, it points to the necessity for going further back before that origin is revealed. Yet it is probable that its roots lie in eastern Asia.

Skull Ornamentation in the Naga Hills.—In *Man* for December, Mr. J. H. Hutton describes a method of ornamentation of the skull of a dead chief which is practised among the Konyak Nagas of Assam. Some of the hair of the dead man is stuck on the forepart of the skull, in front of the spot where the hair was parted in life, to form a sort of fringe. The orbits are filled with white pith in the centre of which the eye is represented by a piece of looking glass, and a nose of pith is also provided. The whole is painted with a blue pigment. The skulls are probably kept in pots covered with flat stones, but produced on special occasions and feasted. If so produced they are probably placed on a sort of a seat and covered at the back with a cloth, as is done at Namsang, where, however, the skull is not given artificial eyes and nose and the forehead is provided with a miniature of the chest tattoo pattern. In Kongan paint seems to be used to represent the hair. The practice of providing artificial eyes and nose is comparable with that of Oceania. The specimen obtained lacked the lower jaw. This was due to its sanctity, which was such that the individual who obtained the specimen for the author did not dare abstract the jaw as well. The sanctity of the jaw may be noted in many parts of the Naga Hills. The jaw of an enemy head is separately dealt with in many Konyak villages and does not come with the rest of the skull to the chief's verandah, nor is it separated from the ancestors' skulls. In the Khasi Hills, as in Borneo, the jaw of an animal slain at the funeral feast is the part specially associated with the remains of the deceased. The explanation may be that the ghost attaches specially to the lower jaw.

Bionomics of the Liver Fluke.—I. Clunies Ross records (*Bull.* 43, Council for Sci. Ind. Res., Commonwealth of Australia, 1929) observations on the bionomics of the liver fluke (*Fasciola hepatica*) of the sheep in New South Wales. The miracidia may remain alive and active for twenty four hours after hatching—hatching occurs during the warmth of the day and the miracidia may survive and swim through the night. At 8°-11° C. they may survive for three days. The intermediate host is *Limnæa brazieri*—no other snail was found naturally infected or could be infected experimentally. The cycle of development of *F. hepatica* in this snail is completed in a minimum of forty nine days in summer. So many as 850 cercariæ were found to issue from one naturally infected snail. The majority of the cercariæ encyst on water weeds near the surface of the water, but some at depths of 2 cm. Many cercariæ resisted desiccation in the shade for seventeen days. After entering a new host the cercariæ penetrate the wall of the intestine and enter the liver. Destruction of the liver tissue increases progressively as the flukes grow therein. There is evidence of a protracted stay in the liver tissue—flukes were present there thirty nine days after infestation of experimental animals and none was found in the bile ducts in this period. Development of *F. hepatica* will take place in *Limnæa brazieri* of all ages from a fortnight old to mature specimens. The snail occurs in varied habitats—shallow, marshy areas and swift flowing rivers—and has two breeding periods—spring and summer. It resists desiccation feebly and hence drought exercises a marked influence. The snail is killed in the laboratory by exposure overnight to copper sulphate in dilution up to 1 in 150,000,000, and eggs are usually killed within twenty four hours in 1 in 1,000,000 copper sulphate. Destruction of the snails has been effected by broadcasting, while light rain is falling, copper sulphate (25-30 lb. to the acre of pasture) mixed with four times its weight of sand. Drainage of the pasture is also helpful.

The 'German' Carp.—Prof. W. M. Smallwood and Mary M. Smallwood discuss the problem of the European carp as an American immigrant in the November number of the *Scientific Monthly*. In 1831, carp were first brought from Europe and introduced into New York waters. Since then they have taken so kindly to America that in some parts they are regarded as a menace. The reason for their success appears to be largely in the feeding habits, for they may be said to be practically omnivorous and often feed in polluted areas which other fishes find impossible. They can live and reproduce in lakes, streams, ponds, and canals in very variable conditions, and are usually wonderfully free from disease. Except for a few Acanthocephala, parasites appear to be absent, the reason probably being that they have left behind their intermediate hosts in Europe. There is in this paper an interesting account of the life history of the carp from egg to adult, with notes on their feeding habits.

Growth of Hawaiian Corals.—Under this title Mr. Charles Howard Edmonson has described the continuation of his experimental work on the bionomics of South Sea corals (Bernice P. Bishop Museum, *Bulletin* 58, Honolulu, Hawaii, 1929). In his former paper in the same publication (No. 45, 1928), "The

Ecology of an Hawaiian Coral Reef", many interesting experiments were described, and in the present part it is shown that still more have been successfully carried out. Much of the new work is in connexion with the planulæ and their post larval development, and three species have been studied, *Dendrophyllia manni*, *Pocillopora cespitosa*, and *Cyphastrea ocellina*. As was previously observed, the planulæ are more resistant to abnormal conditions than the adults of the same species, and they settle and become fixed under a wide range of conditions in the laboratory, frequently in clusters. The species vary in their rate of development, *Pocillopora* before fixation being more rapid than *Cyphastrea*. *Dendrophyllia* can develop even in the total absence of light. In its natural surroundings it thrives under ledges of rock where the light is subdued. The planulæ of *Cyphastrea* were much more easily obtained than the other two, and colonies could almost always be made to release them by gently heating the water surrounding the corals or by plunging them into water of about 35° C. Besides the work on the planulæ, the growth of the shallow water corals was studied. These growths are usually very irregular, although they may be large at times. *Porites* in both massive and branching forms may gain so much as 10 mm in height annually, the massive form 60 per cent, the branching form 80 per cent in weight. *Pocillopora* increases on an average about 15 mm in height annually and more than 100 per cent in weight. The variety *nobilis* can increase in height at the rate of about 40 mm in a year.

Observations on Living Chromosomes in *Obelia*.—The oocytes of *Obelia geniculata* prove to be exceptionally favourable for the study in life of the prophases of the first oocyte division. Miss G. H. Faulkner (*Quart. Jour. Micr. Sci.*, vol. 73, Part II, 1929) records that, owing to the transparency of the medusa and of the yolk of the oocyte, the whole of the nuclear cycle can be examined in detail in living specimens, and that isolated individuals can be re-examined from day to day. In the young resting oocytes the nucleus is almost entirely filled with the nucleolus, which represents a condensed chromatic spireme and includes the whole chromosomal content of the nucleus. During the early growth phases of the oocyte, the nucleolus elongates and fragments, and each fragment has been identified as a pair of homologous chromosomes indistinguishably united. Later, each of these bivalent elements divides into two individual chromosomes. The two components of the largest bivalent element are unequal in size and probably represent an *X Y* pair. The chromosomes at the bivalent and at the univalent phase are seventeen and thirty-four respectively. At a still later stage, the chromosomes fragment into numerous small globules which become evenly distributed throughout the nucleus, and the latter is then seen as a clear vesicle. These observations made on living oocytes have been confirmed in sections of fixed specimens.

Fossil Brachiopods.—An alphabetical list of all the known genera of fossil Brachiopods, with their genotypes, synonyms, systematic position, and geological distribution, has been brought together by C. Schuchert and C. M. Le Vene (*Fossilium Catalogus*, I, Animalia, Pars 42. Berlin: W. Junk, 1929). 702 genera are known, of which 456 are found in the Palæozoic, 177 in the Mesozoic, and 74 in the Cainozoic and Recent. A revised classification of the Brachiopoda is given but without diagnoses of the groups. The order Palæotremata, established by Thomson, is adopted.

Form of Volcanoes.—Most Japanese volcanoes, as Prof. T. Terada remarks, in an interesting paper (*Earthq. Res. Inst. Bull.*, vol. 7, pp. 207-221, 1929), are surrounded by a conspicuous zone of depression. To compare the forms of different volcanoes, he takes the average heights of the surface at given distances from the summit in the sixteen principal directions, and from these he obtains the mean profile of nine Japanese volcanoes. This shows that there is a zone of depression at the foot of the cone, while the land beyond it, between 15 miles and 25 miles from the summit, is generally uniform in level. The depth of the zone of depression below the surrounding ground varies from about 20 ft. to 84 ft.

Origin of Graptolitic Shales.—The view put forward by Marr and by Ruedemann that black shales, containing numerous graptolites with but few other associated organisms, were deposited in the deeper parts of seas similar to the Black Sea, is disputed by Dr. A. W. Grabau (*Mem.* VII, Inst. Geol., Nat. Research Inst. China, 1929). The view that he proposes is that normal graptolite beds were formed on fluviatile plains of the type of the Huang ho of China, the Indo-Gangetic plain of India, the Euphrates-Tigris plain of Mesopotamia, etc. Such plains could exist in all parts of the world in former times as they do to-day, and simultaneous rise of sea-level would inundate them, leaving stranded planktonic organisms like graptolites. During the intervals, only fluviatile terrestrial organisms would be buried in the sediments. No evidence is given of this assumed world-wide and oft-repeated rise of sea-level, nor are any deposits of fresh-water origin known to be associated with graptolitic shales.

Ice of North-East Land.—During the Oxford Expedition to Spitsbergen in 1924, Dr. K. S. Sandford made a study of the glacial conditions in North-East Land. He has published the result of his observations in articles in the *Geographical Journal* for November and December. The ice-sheet consists of three domes, two in the northern part and one in the south-west. These domes merge in the regions of highland ice the normal conditions of land ice in Spitsbergen where underlying topographical features have a marked effect on the configuration of the ice and the direction of its flow. The ice-free margin to much of the land indicates in its erratic blocks and topography a former greater extension of the ice. A long period of subaerial denudation has left its marks on the glacial topography of this margin. Some pre-glacial river valleys have again been occupied by streams. There seems, however, to be no evidence of a further and recent retreat of the ice on such a scale. In fact, much of the ice seems to be in a carapace stage, neither gaining nor losing and not in active movement. No glacier shows signs of a marked advance, but at the head of Wahlenberg Bay there is evidence of a fairly recent retreat with a zone of fresh boulder clay in front of dead ice. Raised beaches around the island bear witness to past uplift. This was at least 200 feet and is still in progress.

Vibrations in the Atmosphere.—There is some indication from the daily fluctuations in the height of the barometer that the atmosphere may have a natural period of vibration of twelve hours. A fresh attempt to obtain this result from dynamical considerations has been made by Prof. G. I. Taylor in a paper in the December number of the *Proceedings of the Royal Society*, on waves and tides in the atmosphere. On the assumption that the temperature falls off with height at half the adiabatic rate, from 20° C. at the surface to −68° C. in the stratosphere, Prof. Taylor, extending an earlier analysis by Dr. H. Lamb, obtains a value of 1065 feet per second for the speed of long gravity-controlled waves in the air

The waves set up by the eruption of the volcano Krakatau in 1883 had actually a speed of 1046 ± 9 feet per second, and it follows from this agreement with theory that their propagation must have been adiabatic Isothermal changes would, however, give a value not far from the 910 feet per second required by the semidiurnal barometric wave Prof Taylor has also analysed Strachey's curves, showing the first passage of the Krakatau wave round the earth, and has found that the lobed form assumed by the wave front can be explained by the existence of a typical east wind of 12 feet per second, passing continuously into a west wind with a maximum of 31 feet per second at lat 57° N or S He also finds that the equivalent depth of the atmospheric ocean is not more than 5 per cent less at the poles than it is at the equator

Electron Diffraction by Mica—In a paper in the *Zeitschrift fur Physik* for Dec 9, on the diffraction of electron waves by mica, Dr E Rupp discusses some of the earlier results obtained by Kikuchi in this connexion (see NATURE, Feb 9, 1929, p 224) With thick sheets of mica, Kikuchi had obtained the diffraction patterns of a three dimensional array of atoms, and with thin sheets the patterns of a two dimensional lattice, some of the thin sheets which he used were, however, of the order of a hundred atoms thick, and it is not obvious why these should not have produced the same results as thicker sheets Dr Rupp attributes the effect to a generation of heat in the mica when it is bombarded by electrons He supposes that the planes of atoms which produce surface effects are relatively little affected as individuals by an increase in thermal motion, but that they undergo sufficiently large shifts with regard to one another to destroy regular volume interference Dr Rupp supports this explanation by experiments in which he has been able to produce either type of pattern with a single specimen of mica simply by varying the electron current to it With the very considerable disengagement of heat that occurs when electron currents of about 0 1 ampere are supplied at a power of 3 kilowatts, it is possible to obtain the patterns from the plane gratings even with a sheet of mica 10^{-4} cm in thickness

Oxide-coated Filaments—It is well known that the electron current from a hot wire can be increased enormously in certain circumstances by coating it with the oxide of an alkaline earth metal, but that the factors which control the emission are complex Some important investigations on these filaments are described by J A Becker, of the Bell Telephone Laboratories, in the second November number of the *Physical Review* It appears probable that high activity is associated with adsorption of the alkaline earth metal at the surface, and that many of the changes which occur in the emission are brought about by electrolysis of metal or oxygen atoms through the oxide, the value of the filament as a source of electrons, as with composite filaments of tungsten and thorium or cæsium, depending on the fraction of the surface covered by the active metal The efficiency of the latter is reduced if it is covered with oxygen atoms, but is increased if it is free on the side facing towards the vacuum, but anchored by oxygen atoms to the main surface By appropriate control of temperature and electron current, either the alkaline earth metal or the oxygen can be made to evaporate The probable process of electrolysis in the oxide is also described in some detail, and it seems that Ohm's law is not valid, although most of the current is carried by electrons, and a relatively small part by ions

Transmission Line Surges—The extending use of overhead wires for power transmission and for working electric railways has made the problem of protecting the network from interference by lightning and by sparks caused by atmospheric electricity one of considerable commercial importance The earlier methods of dealing with surges of electricity due to lightning discharges are now quite unsuitable and the whole problem has to be solved by purely scientific methods The development during the past fifteen years of high vacuum technique has led to the construction of apparatus which can record the effects of lightning on the overhead wires In particular, the cathode ray oscillograph has proved of great value In a lecture on transmission line surges given by Dr H Norinder to the Institution of Electrical Engineers on Dec 5, he described the valuable work that has already been done in Sweden by the oscillograph, both on the surges caused by lightning flashes on actual circuits and in an artificial way in the laboratory The construction of these laboratory surge generators has been made possible by the use of kenotrons which give a pressure of 200 kilovolts By connecting the condensers in series, pressures of ten times this value have been obtained Dr Norinder emphasised the great difference in the effects produced by direct strokes and those produced by induced charges He gave experimental data on the rate of cloud discharge, together with characteristic records of the discharge rate He considered that it is not yet possible to deduce definite conclusions as to lightning surges from the records obtained Further research is urgently required In the discussion, Mr Goodlet, of Metropolitan Vickers, mentioned that his firm has made elaborate researches at Trafford Park with impulse generators producing 1,500,000 volts

X-Rays in the Examination of Coal—Röntgen's discovery of X rays was quickly applied to the needs of clinical medicine and surgery, where a method of examining an opaque living object without disturbance received immediate recognition As time went on, industrial applications were developed in one direction after another Mr C N Kemp's application of X rays to the examination of coal and coke for incombustible impurity may become one of the most important of these It was described in a recent lecture before the Royal Society of Arts (*J R S Arts*, p 114, 1929) Coal is not only opaque but also relatively inert to reagents and solvents Quick analytical separations are precluded The normal mode of determining ash is such as to be incapable of giving an indication of the way in which the ash is distributed in a lump Yet this information is vital to a decision as to the feasibility of coal cleaning Mr Kemp has devised a technique which may well bring an X ray apparatus into every coal-cleaning plant and coal testing laboratory in the near future If the retailer of footwear can use X-ray apparatus, why not the colliery?

Synthesis of Glycine—Methyleneaminoacetonitrile (CH_2 N CH_2 CN)$_3$, which can be prepared from formalin, ammonium chloride, and alkali cyanide, when treated with acid is converted into aminoacetonitrile, which is best separated as the acid sulphate This method of preparation is due to Klages (1903) There is some difficulty in obtaining free glycine from the salts, but in the November number of the *Journal of the Chemical Society*, H King and W K Anslow describe a method which gives a yield of 83 per cent, calculated on the nitrile, of the recrystallised glycine, which consists in boiling the acid sulphate with 27 per cent barium hydroxide solution until evolution of ammonia ceases

The Fifteenth International Geological Congress, South Africa, 1929

THE recent meeting of the Fifteenth International Geological Congress during July and August of last year (under the presidency of Dr A W Rogers), with Pretoria as its headquarters—the first occasion on which the *venue* was in the southern hemisphere—brought together from all parts of the world a large number of geologists, whose eloquent appreciation of the arrangements made for them must have been most gratifying to the organising committee after its two years of labour in carrying through the intricate work of organisation

The experiment of assembling such an international gathering in a country so far removed from the centres of geological progress in Europe and the United States was not viewed without some misgivings Though Nature has lavishly endowed southern Africa with many geological features of exceptional interest and wide significance, besides enriching it with great mineral wealth, the sub continent is essentially a region of wide spaces, requiring a large canvas for their geological portrait, in South Africa, indeed, 'regional' geology seems written in very large letters, so that the visiting geologist needs much time and a longish purse to travel the enormous distances that have to be covered before he can encompass the main designs of the geological structure Moreover, South Africa is a young country in which systematic geological work has been in progress only for a relatively short period, and is being carried on by a comparatively small band of geologists These are some of the difficulties that faced the organising committee when designing the detailed programme

Now that the fifteenth session has passed into history, it is a pleasure (and a relief) to be able to record the complete success of the experiment The total membership was 575 out of which number 300 were present Considering the obvious difficulties and cost involved in participating in the South African meeting, this attendance was very gratifying, specially as it compares favourably with some of the earlier sessions that were held in Europe The 117 delegates who represented geological surveys, museums, scientific societies, and other institutions, included some seventy official delegates of governments, while no fewer than 22 directors of geological surveys were present

Since the geology of South Africa is still relatively little known from an international point of view, the organising committee had designed a series of 22 excursions, covering visits to almost all the most attractive geological areas, as well as introducing the members to all the principal types of mineral deposits, fortunately, the generous support from the South African railway administration, the mining industry and other bodies, allowed the visitors to take part in these excursions in favourable financial and other circumstances The remarkable extent to which members seized these opportunities was certainly a notable feature of the South African meeting, the membership of some of the excursions exceeding a hundred, and many others were fully booked up

The official programme being based on the arrival of the bulk of the Congress at Cape Town before the opening session at Pretoria, two long excursions were provided to demonstrate some of the most important geological features in the Cape Province, such as the structure of the Hex River Mountains, the Karroo geology round Laingsburg, etc, the Kimberley diamond mines and the unique glacial pavements of the Dwyka period near Kimberley, one of these excursions was specially designed for economic geologists and included several days spent in the Witwatersrand goldfields

During the ten days of the session at Pretoria there were several short excursions, all of which were well attended, here the members saw, for example, the beautiful suite of alkaline rock masses near the capital and in the Pilandsberg (Western Transvaal) with its remarkable ring intrusions, and the great opencast workings of the Premier Diamond Mine, visited by 150 members, or the peculiar crater like depression of the Salt Pan in the Bushveld granite north-west of Pretoria, first described by the late Prof E Cohen

After the session at Pretoria there were provided eight long excursions, occupying from three to fourteen days and offering an extensive field of choice from Durban and Port Elizabeth on the east to Windhuk, Luderitzbucht and Tsumeb on the west, and up to Livingstone and Broken Hill in the north, the programme included a visit to the far famed Devil's Kantoor in the great eastern escarpment of the Transvaal Drakensberg, which affords one of the most comprehensive object lessons to be found in the whole of the sub continent for studying the relationship between the interior plateau region and the low lying coastal belt The unique Vredefort Dome with its puzzling tectonics, remarkable overtilting of thousands of feet of the encircling intensity metamorphosed sediments, together with its peculiar ring dykes and startling crush phenomena (profusion of flinty crush rocks), was also included, and gave rise to some interesting discussions in the field The long excursion through Southern Rhodesia to the unique feature of the Great Dyke, etc, and culminating in a visit to the Victoria (Zambezi) Falls, proved of special interest, and nearly a hundred geologists took part in it, it was a happy thought of the Northern Rhodesian Administration to organise a geological tour through that country, so as to enable members of the Congress to see something of its wonderful copper bearing formations that seem destined to develop into one of the most valuable of the Empire's mineral assets Through the hospitality of the Union Minière du Haut Katanga, a special excursion was provided over the remarkable copper fields of the Belgian Congo

Other sections of the official programme took members across the Orange Free State to Durban and into Zululand with its rich cretaceous fauna, to Port Elizabeth, etc, or across South West Africa with its fascinating physiographical problems, etc Another excursion was across the eastern section of the unique Bushveld Complex (including the remarkable tin pipes near Potgietersrust)—embracing an itinerary well away from a railway line under conditions somewhat novel to some of the members—and attracted a very fine membership, including several outstanding workers in magmatic geology Excellent opportunities were offered for seeing the remarkable results of the extreme phases of differentiation in the great norite Lopolith, as illustrated by the chromite and magnetite bands, the anorthosites, etc This itinerary followed very closely that of the Shaler Memorial Expedition of 1922 (under the leadership of Prof R A Daly)

SECTIONAL DISCUSSIONS

The subjects put forward for discussion were chosen, so far as possible, with reference to phenomena of special importance in the geology of South Africa magmatic differentiation, pre Pleistocene Glacial periods, the Karroo System, its stratigraphy, palæontology, and world distribution, the genesis of petroleum, the geological work of micro organisms There was also a general section Having come so far to attend the Congress, the visiting geologists were eager to see as much as possible of South African

geology, so that the excursions were naturally a great attraction to most members, hence it is not surprising that only some seventy papers were communicated, many of these, however, are valuable contributions to matters of wide interest

In the Section dealing with Magmatic Differentiation there were (among other contributions) two papers by Dr E Reuning on "The Differentiation of Karroo Eruptives in South West Africa" and on "Differentiation of South African Rock Magmas", and another by Prof P Niggli on "Some Principles in the Problem of Magmatic Differentiation" The proceedings of this section were most instructive, and very much apropos, in view of the splendid display of magmatic phenomena on the long excursion across the Bushveld, and on that to the Rustenburg Platinum Fields

The remarkable Pre Pleistocene Glacial Deposits of South Africa were discussed in three most useful summaries by Dr A W Rogers (Pretoria), Dr S H Haughton (Cape Town), and Dr A L du Toit (Kimberley) Prof Gortani (Bologna) had a paper on "Continental Drift and Glacial Epochs", while the late Palæozoic tillites in Central Asia and the northernmost Ural were dealt with by E Norin and H G Backlund

A large number of contributions were to the subject of the Karroo System both in its stratigraphical and palæontological aspects, these add much of importance to our knowledge of that system, more especially in its African developments H Besairie ("The Stratigraphy of the Karroo System in Madagascar"), F Dixey ("The Karroo of the Lower Shire Zambezi Region"), A B Walkom ("A Comparison of the Fossil Floras of Australia with those of South Africa"), P Fourmarier ("Karroo System of Belgian Congo"), F Mouta and A Borges ("Sur l Existence et la Distribution du Karroo dans l'Angola"), G Stefanini ("On the Sequence and Age of the Lugh Sandstones, Italian Somaliland") and F P Mennell (Bulawayo), ("The Karroo System in East and Central Africa") are some of the principal contributions

The Rift Valleys Section attracted much interest and brought out some good discussions One of the more notable contributions is by E J Wayland (Entebbe), "The Albertine Rift, a Compressional Phenomena", in which a tectonic parallel is drawn between Lake Albert and the Dead Sea Prof H Cloos (Bonn) gave a thoughtful address on "Tectonic Experiments and the Origin of Fracture Zones", there were also papers by E Seidl (Berlin), J J Pannekoek van Rheden (Haarlem), D Johnson (New York), etc

A great variety of subjects were presented in the General Section, for example, Prof G Gurich (Hamburg) directed attention to the traces of the oldest organisms hitherto found in South Africa, Dr N R Junner (Freetown) gave a useful account of the norite of Sierra Leone, M H J Schuiling (Panda) read a valuable paper on the Kambove Copper Mine (Katanga), while Dr O Pratje (Königsberg) delivered an illustrated address on the results of the geological investigation of the South Atlantic Ocean Other attractive papers were by Prof A Demay (St Etienne) on Hercynian tectonics in France, C Freire d'Andrade (Lourenço Marques) on Portuguese East Africa, P Kovaloff (Johannesburg) on the beryl finds in Namaqualand, A O D Mogg (Pretoria), who discussed the connexion between flora and geology in the Vryburg district, etc

The great interest aroused by recent advances in geophysical methods of prospecting led to a special meeting for this branch of geology, in which Dr J G Sineriz (Spain), Dr D Mushketov (U S S R), and Dr J W Evans (Great Britain) took a prominent part

Following the example set at previous meetings—which resulted in valuable compilations on the world's supplies of, for example, pyrites, coal, iron, etc, it had been decided to survey the "Gold Resources of the World", a subject of outstanding international and economic importance, and specially worthy of being handled by the Congress while meeting in the greatest gold producing country of the world The proposal was initiated by means of a special invitation over the signature of the Prime Minister of the Union, when the session opened, reports had been received from 45 different governments The publication of this volume will be welcomed by many students

International Commissions of the Congress

During the session a series of meetings were held in connexion with the various International Commissions, the work of which is an important feature in the life of the Congress In the end, several commissions had to be reconstituted, one new commission and one sub commission were established, while of the previous bodies, one (iron ores) was dissolved, so that the Congress now has the following commissions Prix Spendiaroff (awarded to Dr L T Nel, geologist on the Geological Survey of the Union of South Africa), Palæontologia Universalis, Lexicon de Stratigraphie, Glaciers, L'Homme Fossile, Croute Terrestre, Géophysique et Géothermique, Carte de l'Europe, Carte de la Terre, Distribution of the Karroo (Gondwana) System, to these was added the sub commission of African Surveys The Council was fortunate in securing an excellent and thoroughly representative membership for most of these commissions

Since the last meeting of the Congress, in Spain during 1926, much useful work has been accomplished by the two map commissions, under the chairmanship of Dr P Krusch, president of the Geological Survey of Prussia The one for the map of Europe on the scale of 1 1,500,000 was founded at Bologna in 1881 and shortly after the Toronto congress in 1913 completed its task by publishing the last sheet, and the preparation of a new edition was afterwards decided upon The indispensable preliminary work of agreeing upon the best colour scheme was completed at a meeting of the Commission held in Berlin last February, and during the South African meeting Dr W Schriel (general secretary of the Commission) exhibited two advance sheets of the new edition, in their original form, the great beauty of the colour scheme and the excellence of the draughtsmanship were much admired by many members One section of the new edition is ready for the press and further sections are expected to appear at the rate of two in each year

The publication of the International Map of the World on the scale of 1 5,000,000 was decided upon at the Stockholm congress in 1910, and the colour scheme drafted at the Berlin meeting referred to, two sections embracing the Union of South Africa being afterwards prepared, they were presented at the Pretoria meeting For the next congress it was agreed to prepare a few North American sections

The final editing is to be done at Berlin (as was formerly the case) in order to secure uniformity of issue, for which purpose a special bureau has been established at Berlin Dr P Krusch (chairman of both map commissions) was able to announce the fortunate circumstance that the means for the printing of both maps have been made available by Prussia, so that in due course the sheets will be obtainable through the Geological Survey of that country

The keen interest shown in the stratigraphy, palæontology and world distribution of the Karroo System which constituted one of the sections of the Congress (as explained above) culminated in the establishment of a new Commission on the Correlation of the Karroo (Gondwana) System, the proposal emanated from Dr S H Haughton (Cape Town)—an outstanding authority on the Karroo System—strongly supported by Prof G Stefanini (Bologna), Dr L L Fermor (Calcutta), Dr D Mushketov (Leningrad) and others The Commission has Dr A W Rogers as chairman and includes the directors of geological surveys (or government geologists) of all countries concerned, together with representatives for Italy Australia, etc with Dr S H Haughton as its secretary, so that one may look to much useful work before long

The presence at the session of representatives of practically every country maintaining some form of geological survey in Africa, led to a strong desire to make use of this unique opportunity of establishing closer co operation between African surveys A number of well attended meetings were followed by the formation of a Sub Commission of African Surveys, on the initiation of Dr G W Grabham (Khartoum) supported by Dr A L du Toit (Kimberley) One of the chief aims of this Commission is "to promote co operation between all Governments in Africa with a view to prosecuting geological mapping of the Continent" Its president is Prof G A F Molengraaff (Delft), whose name is so well known to all students of South African geology, while M Jean Lombard (Brazzaville) is its secretary the membership includes all the chiefs of official geological surveys and those of unofficial geological surveys or their representatives as well as Dr J W Evans It is proposed to issue as soon as possible a "Handbook of the Geology of Central Africa" and to attack the following problems Rift valleys, glacial periods, thrusts, changes of climate, nature of great batholiths, modern sedimentation in connexion with earth movements When one realises the many centres at which geological work is being carried on in Africa practically in watertight compartments, one may look for important results from this new body, which was designated a *sub* commission in order to emphasise the facts that its work is not intended to interfere with that of any commission concerned with the map of Africa

The general meeting of the Congress also asked the Union Government to preserve as a kind of 'Glacial National Park" the beautiful and unique striated pavements near Kimberley which aroused great enthusiasm among the members, and urged the publication of the Contour Map of the Union on the scale of 1 1,000 000 prepared by Mr E H Banks, Cartographer to the Geological Survey The hand coloured original was displayed at the Congress and beyond doubt forms an admirable 'pendant' to the geological map recently published on the same scale

GENERAL IMPRESSIONS

The almost simultaneous meeting of the British Association at Johannesburg had attracted a vast gathering of overseas workers and though it was impossible to secure a fusion between its Geological Section and the Congress a large measure of hearty co operation was possible which the Geological Society of South Africa did much to secure

For the venue of the sixteenth session, the Council had received an invitation from the Comité Géologique in Leningrad, presented by Dr D Mushketov, and another from the United States, presented by Prof C P Berkey Though many members would have welcomed the opportunity of visiting Russia, the general meeting decided in favour of the United States, where the next Congress is to assemble probably in 1932

Surveying the activities of the last session as a whole, one feels that the traditions of this international movement were worthily maintained, both as regards the organisation and general arrangements for seeing the main geological features of the country, and in the contributions made to geological science There can be no doubt that the great success of the excursions the keen interest taken by the visitors in all they saw, and their intense energy in collecting from the crust of the earth, will in due course result in a substantial enrichment of South African literature Certainly the personal contact with so many leaders of geological thought under conditions of perfect international harmony was (and will continue) a splendid stimulus to the little handful of local geologists whose work has to be pursued more or less in the shadows of the light that illuminates the progress of geology elsewhere

A L H

Properties of Water and Steam

THE sixteenth Thomas Hawksley Lecture of the Institution of Mechanical Engineers, delivered by Prof H L Callendar on Nov 1, and entitled "Critical Relations between Water and Steam," takes the form of a very interesting historical survey of the development of knowledge of the physical properties of water and steam Actual measurements of heat quantities and densities at high pressures and temperatures are so difficult and expensive to obtain that this data has always been and still is incomplete, and the physicists' attempts to bridge the gaps by establishing theoretical relations agreeing with experimental results, are described in chronological order

The theory of the continuity of state, which assumes that "liquid and vapour are merely widely separated forms of the same condition of matter, and differ only in density", was so ingenious and attractive that it held the field for sixty years and received a tremendous amount of attention The salient points in its development are, therefore, illustrated, but finally the assumption of identity of molecular structure of water and water vapour was generally abandoned

Recent researches on the structure of crystals suggest the co aggregation theory The density of steam at low pressures shows that the great majority of the molecules are single H_2O molecules, but there is no doubt that steam contains a proportion of complex molecules which increases with the density, and this would account for the increasing defect of volume from the ideal with increasing pressure The latent heat of co aggregation of the complex molecules also explains the increasing defect of total heat with increase of density As regards the water, the co aggregation of the molecules appears to be a higher degree of multiplicity, but is apparently so mobile and irregular as to make analysis almost hopeless However, the relative positions and distances apart of the atoms of crystalline solids, such as ice, have been determined recently with great accuracy, and this shows that their arrangement depends in many important cases on the ionic group formation known to exist in the liquid, rather than on the chemical formula for the molecule in the vapour state

In this connexion illustrations are given of Sir William Bragg's model of the crystal structure of ice, and the continuous nature of the network is described It is shown that there is no trace of the original vapour molecule, except that the total number of hydrogen

atoms in the crystal is exactly twice that of the oxygen atoms The complete hexagonal molecule existing in the ice is one of the most probable types existing in the liquid, but there must be many others of greater degrees of complexity, and the reduction of the proportions of complex molecules with increase of temperature helps to explain the high specific heat of water and the reduction of the latent heat This proportion becoming insufficient to maintain a continuous network would explain the vanishing of the surface tension at the critical point The vapour would probably contain molecules of a small degree of complexity, but they would doubtless behave as gas molecules, having the same kinetic energy but lower velocity on account of their greater masses This all indicates that the same type of equation cannot satisfactorily represent the behaviour both of the liquid and the vapour

Based on this theory the following modified Joule-Thomson equation is adopted

$$V - b = RT/P - C,$$

in which C represents the defect due to co aggregation The heat of water in equilibrium with saturated steam can be represented by

$$h = So\ (t - 32) + vL\ (V - v),$$

which equation has been verified by direct measurement of h up to 3800 lb pressure These two equations combined enable the saturation pressures to be calculated by Rankine's method, and give good agreement with observation up to 400° F with C a function of T only For higher temperatures it will be possible, by making C a function of P as well as of T, to obtain good agreement over the whole range, 32° to 717° F

Densities have been determined by heating suitable quantities of water in sealed quartz glass tubes The density of the liquid was determined by observing its expansion up to the temperature at which the meniscous vanished, which was found to be 705 2° F The density of the vapour was determined by using smaller quantities of water and observing the temperature at which the liquid was completely evaporated The densities did not become equal at the temperature at which the meniscus vanished but were in the ratio of 5 to 3

A method of determining the total heats in the critical region gave values consistent to 0 1° F and corresponded remarkably well with the density measurements The latent heat at 705 2° F, where the meniscus vanished, was found to be 130 B T U per lb and the saturation lines for liquid and vapour do not meet at 705 2° F but at 717° F and at a pressure of 3650 lb, while the density curves from the quartz tube experiments do not meet at 705 2° F in a parabola but at about 717° F when extrapolated

In discussing a diagram of total heat plotted to a base of log pressure, a statement is made which suggests that with steam at an initial temperature of 670° F a higher thermal efficiency is obtained with 500 lb per sq in than with 1000 lb per sq in initial pressure The reference is to the dry region, and presumably therefore only a small range of expansion is considered However, if the comparison is made on a practical basis, with expansion to a common final pressure of such value as obtains in an ordinary steam power plant, the higher initial pressure produces a considerable gain in thermal efficiency, because not only is the available energy due to adiabatic expansion greater, but also the heat input is less These facts are quite easily established by calculating the required values from any published tables of properties of steam, including those published by Callendar himself It is unfortunate that this wrong impression should be created by a statement of so great an authority on the subject, particularly at a time when progressive engineers everywhere are fighting against conservatism in their effort to introduce higher initial steam pressures into large steam power plants with the object of improving the overall efficiency

University and Educational Intelligence

EDINBURGH —The degree of D Sc has been conferred upon Prof R S Adamson for his thesis on studies in plant ecology and in plant anatomy, and on Robert Neil Chrystal for his thesis on *Sirex* and the *Ibalia* parasite—the biology and post embryonic development of *Ibalia leucospoides*

ST ANDREWS —The Court has approved the nomination of Dr E T Copson, formerly scholar of St John's College, Oxford, lecturer in mathematics in the University of Edinburgh and honorary secretary of the Edinburgh Mathematical Society, as lecturer in mathematics and applied mathematics in succession to Dr William Saddler, who has recently been appointed to the chair of mathematics at Christchurch, in the University of New Zealand

MEMORANDA have been issued regarding the various Commonwealth Fund Fellowships available in 1930 The fellowships are open to British graduate students and tenable in American universities As many as thirty fellowships, tenable for two years, are available to graduates of British universities who are domiciled in the British Isles, are of British descent, unmarried, and less than thirty years of age Not more than five fellowships are also available on similar terms to graduates from any of the British Dominions A further class of fellowships, limited to three a year, is offered to overseas government officers in the actual employ of the Government of Great Britain, India, or any of the Dominions, the age limit for these fellowships is thirty five years and they may be married Every fellow appointed has to submit a course of study or research, and is expected to travel about the United States in connexion with his work There is no fixed emolument, but each fellowship is estimated to cost the Fund about £600 a year Particulars and application forms, to be returned by Feb 10, can be obtained from the secretary, Mr R H Simpson, Commonwealth Fund Fellowships, 50 Russell Square, London, W C 1

THROUGH the generosity of Mr P F Holmes and Mr D M Henshaw of Huddersfield, there has been placed in the hands of the Institution of Gas Engineers a fund for the purpose of endowing a scholarship to be called the William Cartwright Holmes Scholarship, which shall be tenable at the University of Leeds by a student taking a course in preparation for a responsible position as a gas engineer The scholarship is of the value of £150 per annum for three or four years The donors of the scholarship state that "their first desire was to perpetuate the name of William Cartwright Holmes, and secondly to show appreciation of the training obtained by students of Gas Engineering at Leeds University and of the valuable research work done in the Department of Coal Gas and Fuel Industries" The foundation of such a scholarship is a very practical means of assisting to meet the national need at the present time for trained fuel technologists which was stressed by the National Fuel and Power Committee in its recent report and by Prof J. W Cobb in his last report as Livesey professor of the Department of Coal Gas and Fuel Industries in the University of Leeds

Historic Natural Events

Jan 12, 1914 Eruption of Sakura-jima —A violent eruption occurred in the island volcano of Sakura jima in south Japan It was preceded by many tremors on Jan 11, and these led the authorities to order the removal of the inhabitants, and all of them (more than 23,000 in number) were saved Lava flowing down the east side filled up the narrow strait and converted Sakura jima into a peninsula The total volume of ashes and lava ejected was estimated at one half a cubic mile New surveys showed that most of the volcano was uplifted, in one place by 41 feet Outside the island, the ground was depressed by so much as 20 inches within an irregular circle about 28 miles in diameter

Jan 14, 1716 High Tide during Frost Fair —The winter of 1715–16 was very cold in England and over the whole of Europe At Paris the thermometer fell to -4° F on Jan 22 A fair, with booths and printing presses, was erected on the frozen Thames, on Jan 14 there was an uncommonly high spring tide, which raised the ice fourteen feet without interrupting the progress of the fair

Jan 15, 1662 Mild Winter —Under this date Samuel Pepys records in his diary "It is a fast day ordered by the Parliament, to pray for more season able weather, it having hitherto been summer weather, that is, both as to warmth and every other thing, just as if it were the middle of May or June, which do threaten a plague (as all men think) to follow"

Jan 16, 1362 Gale —A gale began about the time of evensong and continued for six or seven days in the south of England, stronger than had been known for many years It blew down towers, steeples, houses and chimneys, and even the buildings that were not overthrown were rendered unsafe It was followed by a very wet season in summer and harvest

Jan 16, 1614 Frost —It is recorded in Drake's "Eboracum" that on Jan 16 "it began to snow and freeze, and so by intervals snowing without any thaw till the 7th of March following, at which time was such a heavy snow upon the earth as was not re membered by any man then living It pleased God that at the thaw fell very little rain, nevertheless the flood was so great that the Ouze ran down North Street and Skeldergate with such violence as to force all the inhabitants of those streets to leave their houses Ten days this inundation continued at the height and many bridges were broken down by it in the country, and much land overflown"

Jan 17, 1830 Severe Winter —On the continent of Europe the winter of 1829–30 was one of the most rigorous known in history On Jan 17 the thermo meter at Paris fell to 1° F and public 'warmers' were established in the streets In Switzerland instead of snow, small compact crystals of ice fell, as in polar regions In Normandy the snow was more than six feet deep, and many wood gatherers were lost The frost was especially severe in Spain, where communica tions were interrupted, many lives were lost, and many thousands of cattle Bands of wolves, driven from the mountains by the snow, caused great ravages among the herds and killed many people In England this winter was not especially severe

Jan 17, 1881 Low Temperature in Britain —On Jan 7–26 severe frost prevailed over the whole of Great Britain and Ireland, unequalled since the winter of 1814 The lowest temperatures occurred on Jan 17, when the thermometer fell below zero over the south of Scotland and the north of England, reach ing -22° F at Blackadder (Berwickshire), -16° at Kelso, -15° at Stobo, and -11° at Lauder, all in the valley of the Tweed Again on Jan 26 a temperature of -16° F was recorded at Blackadder, but there is some doubt whether the exposure of the thermometer at this station was satisfactory These low tempera tures all occurred during a period of light northerly winds

Jan 18, 1881 Great Snowstorm —A barometric depression, which originated off the east coast of the United States on Jan 10, crossed the Atlantic in a general easterly direction, and on the evening of Jan 17 it traversed the Bay of Biscay At 8 A M on Jan 18 it was very intense and lay near the Channel Islands, and throughout that day it moved slowly and rather irregularly over the central parts of the English Channel before passing away to Germany on Jan 19 Over the Midlands, east and south east England, the most violent easterly gale on record blew throughout Jan 18, the velocity at Yarmouth being 73 miles an hour for fifteen minutes between 3 and 4 P M The gale was accompanied by heavy snowstorms over nearly the whole of England, and in many places the railway lines were completely blocked for many hours In London the snowstorm was the worst within living memory, and owing to the high wind curious drifting effects were experienced, some streets being perfectly clear on one side but heavily piled with snow on the other The fall was especially heavy in the Isle of Wight, where it was quickly followed by a second on Jan 20, in Cowes there were drifts in the streets 12 feet deep

Jan 18, 1926 Hurricane —A very violent hurri cane ravaged all the Canary Isles Torrential rain overflowed the water courses and a great deal of damage was done by rain and wind At Las Palmas scarcely a house was left standing

Societies and Academies

PARIS

Academy of Sciences, Nov 25 —**L Mangin** Notice of Sir Ray Lankester, foreign associate of the Academy —**Gabriel Bertrand** and **L Silberstein** The estimation of sulphur and phosphorus in plants It was proved that the proportion of sulphur remaining in the ash is always less than that which exists in the plant, the losses ranging from 44 per cent to 76 per cent There is also a loss of phosphorus during cal cination to ash, but the losses are much less from 0 2 per cent to 7 per cent of the amount present —**J A Le Bel** The sparks which are emitted by stalactites when violently struck with a steel tool It was at first supposed that these sparks were due to the presence of quartz particles in the rock, but it was later proved that no hard particles were present The phenomenon is probably due to triboluminescence —**G Friedel** and **V Maikowsky** Temperature measure ments in borings The thermometer consists of an ungraduated bulb with capillary tube, with the upper end open and ground to a plane face making an angle of 45° with the tube The actual temperature at which the tube is exactly full, corresponding to the temperature attained in the boring, is easily deter mined in the laboratory —Ernest Esclangon was elected a member of the Section of Astronomy in the place of the late P Puiseux —**Herbert Ory** The ex traction of roots —**H Milloux** Some properties of meromorph and holomorph functions —**Joseph Pérès** Some results concerning the stability or the regularity of the movement of a viscous liquid —**G P Arcay** Contribution to the experimental study of the de formation of the flat spiral From the experimental evidence given in the paper, it is concluded that the static deformation and the kinematic deformation of

the flat spiral, corresponding to the same position of the balance wheel, are in all cases identical Consequently, it is legitimate to utilise the method of static deformations as a method of experimental control — **Louis Hirschauer** and **Augustin Talon** The auto railroad proposition for rapid transport with high duty —**G Bruhat** and **R Legris** The rotatory dispersion of tartaric acid and of the alkaline tartrates in aqueous solution —**Jean Thibaud** and **Jean J Trillat** The effects of filtration of the general radiation on the X ray diagrams of liquids The determination of absorption coefficients The existence of a secondary diffraction ring due to the general radiation, shows the necessity, in researches on the molecular structure of substances radiographed in thicknesses of several millimetres, of precautions against the formation of the secondary ring For this, either the radiation may be made monochromatic by reflection from a crystal, or an absorbing sector of aluminium may be placed near the film —**M Bourguel** and **Mlle V Gredy** The mechanism of catalytic hydrogenation Whatever may be the mode of working, the initial velocity of hydrogenation is, for a given substance, independent of the weight of material to be hydrogenated The activity of the catalyst is a diminishing function of the initial concentration The results can be best explained by the assumption of an initial action of the hydrogen on the metal (palladium) —**L Meunier** and **K Le Vlet** The hydrophil properties of collagen Any substance capable of lowering irreversibly the capacity of the collagen for swelling is a tanning substance, and its astringency is measured by the intensity of this lowering —**Jacques Bardet** and **Arakel Tchakirian** Some combinations of germanium oxide and oxalic acid Experimental evidence is given for the existence of a complex germano oxalic acid it was not possible to isolate a definite compound, but $H_2Ge(C_2O_4)_3$ is probably present in the solution —**Mme Ramart-Lucas** and **F Salmon-Legagneur** Stability in absorption spectra The absorption in the ultra violet of the dibasic acids of the fatty series - **P Mondain-Monval** and **R Quanquin** The temperature of spontaneous inflammation of gaseous mixtures of air and saturated hydrocarbons The influence of the pressure and of preliminary heating Supplementing earlier work in which the oxidation was carried out under high pressures, experiments at the ordinary pressure are described With pentane, aldehydes were detected at 200° C, and were produced in quantity at 325° C The presence of formaldehyde, acetaldehyde, butyraldehyde, and fatty acids was proved —**G Dupont** and **J Lévy** The autoxidation of abietic acid The action of catalysts In a previous communication the autoxidation of abietic acid was shown to be a typical example of autocatalysis The influence of the addition of catalysts has now been studied cobalt abietate proved to be the most active positive catalyst **Lucien Dupont** : The action of caustic alkalis at high temperatures on albumenoids The proportions of oxalic, benzoic, and various fatty acids obtained by potash fusion at 325° C are given for gelatine and for egg albumen —**J Grard** Some reactions of propargyl acetal —**A Guyot** and **M Fournier** A new general method for the preparation of primary and secondary amines The reaction proposed is $R\ CH_2OH + R'NH_2 = R\ CH_2\ NHR' + H_2O$ This takes place in an autoclave in the presence of reduced nickel at temperatures from 150° to 190° C If ammonia is used in place of the primary amine, both primary and secondary amine are formed in proportions depending on the temperature The yields are high and the method appears to be general —**D Ivanoff** Some properties of the true mixed organo magnesium carbonates —**L Royer** New observations on the asymmetry of the corrosion figures obtained by an active isotropic liquid —**E Raguin** Subdivisions of the layer of bright schists in Haute Maurienne — **Yang Kieh** The massif of crushed pegmatite situated at the southern edge of the geological sheet of Aigurande (scale 1/80,000) —**Marcel Thoral** Palæontological discoveries in the Cambrian and Silurian of the mountains of Lacaune to the north of the Montagne Noire —**J Thoulet** Isothermal oceanic liquid cones of whirling —**R Combes** and **M Piney** Proteolysis and proteogenesis in ligneous plants during the summer and autumn —**A Orékhoff** The alkaloids of *Anabasis aphylla* This plant, which grows wild in Turkestan and Transcaucasia, is known to be very poisonous A new base, anabasine, $C_{10}H_{14}N_2$, has been extracted from the dry plant and prepared pure Other bases, not so far obtained pure enough for analysis, are also present —**G Nicolas** and **Mlle Aggéry** A new example of generalised bacterial infection in plants —**J André Thomas** The phenomena of modification of toxic attack of the Convoluta as a function of their grouping —**Jean Saidman** Radiotherapy of aerophagy

Dec 2 —**Marcel Brillouin** The dynamical tides of an ocean comprised between two parallels Law of depth in latitude and longitude The organisation of the calculations —**Léon Guillet** and **Marcel Ballay** The corrosion of steels after cementation or formation of nitride —Charles Nicolle was elected a non resident member in the place of the late Ch Depéret -**O Borůvka** Projectively deformable surfaces which admit a group of ∞' projective transformations in themselves — **Fatou** A criterion of stability —**Nicolas Théodoresco** The application of a formula generalising the Cauchy integral to a hydrodynamical question — **Jean Courrégelongue** The existence of two families of vortices behind immerged solids —**L Ravier** A general formula for the calculation of the thrust of the soil —**Paul Woog** The extension of lubricants on solid surfaces Molecular influences The rôle of photolysis —**Marcel Chopin** The flow of gas through an orifice in a thin wall at variable temperatures —**P Swings** The resonance series of sulphur vapour —**L Goldstein** The relativist treatment of the problem of several bodies —**Frédéric Joliot** The electrochemical properties of polonium — **Mlle Dorabialska** The heat evolved by polonium The amount of heat evolved, reduced to a quantity of polonium in radioactive equilibrium with 1 gram of radium, was found to be 24 calories per hour This figure is given with reserve, since it is distinctly below that deduced from the heat measured for radium and its derivatives —**Maurice Lecat** The prediction of binary azeotropism —**Roger Lyon, G Fron,** and **Fournier** The influence of artificial ageing on the mechanical properties of wood Data are given showing the effects of mild and drastic treatment with ozone on wood —**Raymond Hocart** and **Jacques de Lapparent** The bœhmite of bauxites The identity of Bœhm's 'bauxite' with bœhmite was proved by the application of Debye and Scherrer's method — **Constant Ktenas** New researches on the petrochemical characters of the caldeira of Santorin — **Maurice Couvreur** Note on the conformal and non conformal siliceous epigeny of the testa of Lamellibranchs —**H de Böckh** and **P Viennot** The geology of Iraq —**Raymond Furon** The position of the palæozoic grits to the north of the middle Niger (French Sudan) —**Y Milon** The presence of glauconite in the Pliocene sands of Brittany —**G Pontier** and **R Anthony** The presence of four upper incisors in the *Mastodon (Tetrabelodon) turicensis* —**Georges Malençon** The first stages of germination of the

spores of the genus *Elaphomyces* —**Paul Guérin** The proportion of hydrocyanic acid in the genus *Lotus* Determinations of the amount of hydrocyanic acid in twelve species of *Lotus* have been made The proportions found depend on the time of year the specimens were collected, and also on the climate —**Georges Truffaut and I Pastac** The chemotherapy of plant diseases by organic colouring matters It has been proved that certain colouring matters, innocuous to the higher animals, can prevent the development of moulds (*Rhizopus nigricans, Penicillium glaucum*) The treatment has been successfully applied to diseases of the vine and of wheat —**Laurent Raybaud** The action of germinated seeds in feeding Sterile germinated grain has marked beneficial effects when taken with other food It has proved especially valuable with rickets in children —**Jean Piveteau** A new type of fossil fish from the north of Madagascar —**Emile F Terroine and Mlle Thérèse Reichert** The action of mineral substances on endogenous nitrogen metabolism —**P Vayssière** The migratory Acridians in French Africa during the year 1929 —**L Lavauden** The wild cat of Corsica —**Ch Pérard** The caoutchouc conger In the fish market at Paris congers are occasionally sold the flesh of which differs from that of the normal conger eel, resembling india rubber hence its name Analyses of the flesh of the abnormal eel showed that its consistency was due to a reduction in fat, 0 4 per cent instead of 9 per cent, and this was shown to be due to a concentration of the fat in the ovary —**Marc de Larambergue** Cytological study of autofertilisation in *Limnæa auricularia* —**W Arciszewski and W Kopaczewski** The buffer power of serum Human serum can be treated with either acid or base to a concentration of about $M/2000$ without change in the concentration in hydrogen ions or hydroxyl ions This buffer action extends to other ions The serum offers resistance to any change in its surface tension —**L Marchlewski** Researches on phylloerythrin Phylloerythrin is a product of metabolism of chlorophyll and is identical with the bilipurpurin of Lobisch Its composition is represented by $C_{33}H_{34}N_4O_3$ and when crystallised from chloroform it gives crystals containing one molecule of chloroform to two molecules of phylloerythrin —**Maurice Piettre** The influence of neutral salts on the separation of proteins by the acetone method The effect of salts (magnesium sulphate) is very important in the separation of proteins by the acetone method Small quantities of neutral salts prevent, or at least render difficult, the isolation of the proteins of the globulin group —**Marage** The causes and consequences of the deafness of Beethoven —**Ch Champy and M Heitz-Boyer** The mechanism of the action of the electrical knife with high frequency Thermal and mechanical effects of high frequency currents on the tissues

Official Publications Received

BRITISH

The Common Commercial Timbers of India and their Uses By H Trotter Pp x+153+18 plates (Calcutta Government of India Central Publication Branch) 1 12 rupees 3s

Canada Department of Mines Mines Branch Investigations of Fuels and Fuel Testing (Testing and Research Laboratories) 1927 (No 698) Pp. ii+107+10 plates (Ottawa F A Acland)

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1283 (Ae 388) The Graphical and Analytical Determination of Stresses in Single Span and Continuous Beams under End Compression and Lateral Load with variations in Shear, Distributed Load and Moment of Inertia. By H B Howard (L F 15) Pp 30+18 plates 2s net (London H M Stationery Office)

Survey of India Geodetic Report, Vol 3 From 1st October 1926 to 30th September 1927 Pp xii+163+19 plates 8 rupees 5s 3d Professional Paper, No 22 Three Sources of Error in Precise Levelling. By Capt G Bomford Pp iii+40+5 plates 1 8 rupees 2s 6d (Dehra Dun)

FOREIGN

Department of the Interior U S Geological Survey Professional Paper 158 A The Occurrence and Origin of Analcite and Meerschaum Beds in the Green River Formation of Utah Colorado and Wyoming By Wilmot H Bradley (Shorter Contributions to General Geology 1929) Pp ii+7+3 plates (Washington D C Government Printing Office)

R Osservatorio Astrofisico di Catania. Annuario 1930 Pp iv+50 (Catania)

Guide to the Institute of Physical and Chemical Research Tokyo Pp 50 (Tokyo)

Scientific Papers of the Institute of Physical and Chemical Research Nos. 214 218 Über Celluloseamin und Celluloseanilin von Ichiro Sakurado Benzyläther der Cellulose von Tadashi Nakashima Stupeca Fenomeno ĉe la Senakvigo de Kalcio Sulfato de Sigeru Yamane On the Difference of Behaviours of Different Parts of Three Part Spark in Igniting Combustible Gas Mixture by Torahiko Terada, Kiyohiko Yumoto and Ryûzo Yamamoto Thermal Conductivity of Snow, by Masao Kuroda Pp 118 159 (Tokyo Iwanami Shoten) 65 sen

CATALOGUES ETC

Siemens Loaded Submarine Telephone and Telegraph Cables (Pamphlet 200A) Pp 62 (London Siemens Brothers and Co Ltd)

Calendar for 1930 (Newcastle on Tyne C A Parsons and Co Ltd)

The Nickel Bulletin Vol 2 No 6 December Pp 177 224 (London The Mond Nickel Co Ltd)

Bibliography a Catalogue of Books, Pamphlets Tracts, etc relating to all that concerns the Production Collection and History of Books (Catalogue 521) Pp 64 (London Francis Edwards Ltd)

B D H Vitamin Products Pp 28 (London The British Drug Houses Ltd)

Vancoram Review including a Résumé of Current Literature on Vanadium its Alloys and Compounds Vol 1 No 1 October 1929 Pp 35 (New York Vanadium Corporation of America)

The Detection and Investigation of Poisons by Spectroscopy Pp 18 (London Adam Hilger Ltd)

Diary of Societies

FRIDAY JANUARY 10

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 3 30 —H G Watkins By Canoe and Dog Sledge in Labrador (Christmas Lectures) (2)

ROYAL SOCIETY OF ARTS (Indian Section) at 4 30 —Sir Basil P Blackett The Economic Progress of India

ROYAL ASTRONOMICAL SOCIETY, at 5 —E A Kreiken The Frequency of Double Stars of Different Spectral Types and Absolute Magnitudes —J Jackson The Shortt Clocks of the Royal Observatory Greenwich with Special Reference to the Effect of Variation in Arc —H Jones Deviations from Boyle's Law in Stellar Interiors

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College), at 6

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle upon Tyne) at 6 —I C Burrill Design and Construction of the Rail car carrying Steamship *Seatrain*

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (at Engineers Club Manchester) at 7 —Dr E K Rideal Some Aspects of Surface Chemistry and their Industrial Implications

INSTITUTION OF ELECTRICAL ENGINEERS (North Western Centre) (at Free Trade Hall Manchester), at 7 —Capt P P Eckersley Broadcasting by Electric Waves (Faraday Lecture)

OIL AND COLOUR CHEMISTS ASSOCIATION (Manchester Section) (at Milton Hall Manchester) at 7 —Prof T P Hilditch Recent Research on Fats bearing upon the Drying of Oils in Paint and Varnish

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Cardiff Technical College) at 7 15 —E H Williams Graphitic Lubricants

JUNIOR INSTITUTION OF ENGINEERS, at 7 30 —H J N Riddle The Track Circuit in Railway Signalling

GEOLOGISTS ASSOCIATION (at University College), at 7 30 —J Pringle The Geology of Ramsey Island (Pem) *Papers to be taken as read* —The Palæobotany of the Kent Coalfield Dr R Crookall and J Pringle The Preparation of Thin Sections of Friable and Weathered Materials by Impregnation with Synthetic Resins R J Schaffer and P Hirst

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Burlington House) at 8 —J R Booer Autogenous Welding in Chemical Works

PHILOLOGICAL SOCIETY (at University College), at 8 —G G Loane Notes on N E D

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) at 8 30 —Dr F W Edridge Green The Influence of the Parafoveal on the Foveal Region of the Retina —J D N Cardell Krukenberg's Spindles —E Wolff A Microphthalmic Family

SATURDAY JANUARY 11

BRITISH ASSOCIATION OF MANAGERS OF TEXTILE WORKS (at Manchester Athenæum) at 6 30 —J R Wollaston Recent Developments in Steam Generation

MONDAY JANUARY 13

ROYAL SOCIETY OF EDINBURGH, at 4 30 —G Bond The Occurrence of Cell Division in the Endodermis —D Catcheside Chromosome Linkage and Syndesis in *Œnothera* —D R R Burt A Case of Intersexuality in *Bos indicus*, with a Theory of the Significance of the Genetic Male Intersex

INSTITUTE OF TRANSPORT (at Institution of Electrical Engineers) at 5 30 —A Davies The Co ordination of Transport.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Queen's Hotel, Birmingham), at 7 —H K Whitehorn Petrol Electric Vehicle Characteristics

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—A. Morgan and others: Discussion on Efficiency.
INSTITUTION OF ELECTRICAL ENGINEERS (North Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—H. W. Taylor: Voltage Control of Large Alternators.
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members and Graduates Section) (at Borough Polytechnic), at 7.—H. A. Leadbeater: Oil versus Solid Fuels.
CERAMIC SOCIETY (at North Staffordshire Technical College, Stoke-on-Trent), at 7.30.—J. W. Thompson: A New Method of Decoration of Glazed Tiles.—N. D. Wood: Research into the 'Buckling' of Floor Tiles.—R. M. Colles: Heat Losses from Exposed Surfaces.
INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—A. Wragg: Extrusion, and a Consideration of some of the Physical Properties affecting the Production of Rods, Tubes, and Sections by this Process.
ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Dr. T. F. Chipp: Forests and Plants of the Anglo-Egyptian Sudan.
INSTITUTE OF BREWING (London Section) (at Charing Cross Hotel).—I. Stewart: Malting Barleys of 1929.

TUESDAY, JANUARY 14.

SOCIETY FOR THE STUDY OF INEBRIETY (at Medical Society of London), at 4.—Dr. W. Brown and others: Discussion on The Rôle of Psychotherapy in the Prevention and Treatment of Alcoholism and other Drug Addictions.
MINERALOGICAL SOCIETY, at 5.30.—Sir Douglas Mawson: On the Occurrence of Potassium Nitrate near Goyder's Pass, McDonnell Ranges, Central Australia.—Dr. L. T. Nell: On a New Occurrence of Yunyite near Postmasburg, South Africa.—F. N. Ashcroft: Exhibiting Minerals from Broken Hill, Rhodesia, and Other Localities.—W. Campbell Smith: Exhibiting Specimens and Photomicrographs of Volcanic Rocks from Kenya Colony.
INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—A. A. Ashworth: Efficiency in the Distillation of Light Oils from Crude Oil.
INSTITUTION OF CIVIL ENGINEERS, at 6.—A. E. L. Chorlton: Railway Traction by Oil Engines.
INSTITUTE OF MARINE ENGINEERS, at 6.30.—Eng. Rear-Adml. W. M. Whayman: Water Tube Boilers for Merchant Ships.
INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—I. Scott Mackenzie and others: Discussion on Colliery Electrification.
INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at North British Station Hotel, Edinburgh), at 7.—Lt.-Col. S. E. Monkhouse and L. C. Grant: The Heating of Buildings Electrically by means of Thermal Storage.
MANCHESTER ATHENÆUM TEXTILE SOCIETY (at Manchester), at 7.—H. Keat: Insurance of Goods against Marine Risks.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—I. M. Thomson: The Bittern and its Neighbours.
BURNLEY TEXTILE SOCIETY (at Burnley), at 7.15.—J. Leigh: Ropes and Rope Driving.
INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at King's Head Hotel, Coventry), at 7.30.—J. B. Hoblyn: Aluminium Alloys from the Users' Point of View.
INSTITUTE OF METALS (North East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—I. Wright: Chromium Plating.
QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W.1), at 7.30.—J. M. Offord: Fifty Years with the Quekett Microscopical Club.
WEST KENT SCIENTIFIC SOCIETY (at Wesleyan Hall, Blackheath), at 8.30.
ROYAL SOCIETY OF MEDICINE (Psychiatry Section), at 8.30.—Dr. M. Critchley: The Psychology of the Senile Psychoses.
PHARMACEUTICAL SOCIETY, at 8.30.—P. A. W. Self: Research (Harrison Memorial Lecture).
INSTITUTE OF BREWING (Scottish Section) (Annual General Meeting) (at Caledonian Hotel, Edinburgh).—A. C. Doull and S. E. Barnett: A Few Notes on some Physical Aspects of Fermentation and their Relationship to Brewing Practice.

WEDNESDAY, JANUARY 15.

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.
ROYAL SOCIETY OF MEDICINE (Surgery: Sub-Section of Proctology), at 5.30.—J. P. Lockhart-Mummery: Cinematographic Demonstration of The Operation of Perineal Excision of the Rectum, to be followed by a Clinico-Pathological Meeting.
INSTITUTION OF CIVIL ENGINEERS (Informal Meeting), at 6.—Prof. S. M. Dixon: Developments in Transportation by Cableways.
INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—H. A. Thomas: A Method of Measuring the Overall Performance of Radio Receivers.
INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.—Lt.-Col. S. E. Monkhouse and L. C. Grant: The Heating of Buildings Electrically by means of Thermal Storage.
SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—R. D. Burn: Methods of Filtration in Industry.
BACUP TEXTILE SOCIETY (at Natural History Rooms, Bacup), at 7.30.—H. Mande: Plain Calico Weaving.
TEXTILE INSTITUTE (Yorkshire Section) (at White Swan Hotel, Halifax), at 7.30.—H. W. Martin: Humidification in Textile Works.
ROYAL METEOROLOGICAL SOCIETY (Annual General Meeting), at 7.30.—Sir Richard Gregory: Weather Cycles and Weather Recurrences (Presidential Address).—Presentation of Symons Medal to Dr. G. C. Simpson.
ROYAL SOCIETY OF ARTS, at 8.—J. Burton: Quality in Pottery.
ENTOMOLOGICAL SOCIETY OF LONDON (Annual Meeting), at 8.
FOLK-LORE SOCIETY (at University College), at 8.—Dr. W. R. Halliday: Some Notes on the Superstitious Man of Theophrastus.
ROYAL MICROSCOPICAL SOCIETY (Annual General Meeting), at 8.—J. E. Barnard: Resolution and Visibility in Medical Microscopy (Presidential Address).

HASLINGDEN DISTRICT TEXTILE SOCIETY (at Grammar School, Haslingden).—H. L. Trudgill: Slay Construction and the Care of a Fast Reed Slay.
SOCIETY OF DYERS AND COLOURISTS (Midlands Section) (at University College, Nottingham).—Dr. S. G. Barker: Measurement of Fading.
SOCIETY OF GLASS TECHNOLOGY (at Sunderland).

THURSDAY, JANUARY 16.

ROYAL SOCIETY, at 4.30.—J. R. Marrack and F. C. Smith: The Composition of Diphtheric Toxin—Anti-Toxin Floccules.—F. G. Spear: The Delayed Lethal Effect of Radium on Tissue Cultures *in vitro*.—J. T. Cunningham: The Vascular Filaments on the Pelvic Limbs of *Lepidosiren*, their Function and Evolutionary Significance.—*To be read in title only*.—Sir Frederick Keeble, M. G. Nelson, and R. Snow: The Integration of Plant Behaviour. I. Separate Geotropic Stimulations of Tip and Stump in Roots.—C. Todd: Cellular Individuality in the Higher Animals, with special reference to the Individuality of the Red Blood Corpuscle.—J. Ewles and J. B. Speakman: Examination of the Fine Structure of Wool by X-Ray Analysis.
LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—Prof. J. E. Littlewood: Mathematical Notes (12): On Functions Subharmonic in a Circle (III.).—R. E. A. C. Paley: On Some Problems connected with Weierstrass's Non-Differentiable Function.—S. Verblunsky: On the Limit of a Function at a Point. On the Denjoy Integral.—Dr. D. M. Wrinch: On an Integral Involving Legendre Functions and Related Integrals.
INSTITUTE OF METALS (Birmingham Local Section) (at Chamber of Commerce, Birmingham), at 7.—J. Fallon: Modern Annealing Furnaces.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Kinematograph Group—Informal Meeting), at 7.
INSTITUTION OF ELECTRICAL ENGINEERS (Hampshire Sub-Centre) (at University College, Southampton), at 7.30.—Lt.-Col. S. E. Monkhouse and L. C. Grant: The Heating of Buildings Electrically by means of Thermal Storage.—T. G. N. Haldane: The Heat Pump—An Economical Method of Producing Low Grade Heat from Electricity.
INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Society of Chemical Industry—Edinburgh and East of Scotland Section) (at 36 York Place, Edinburgh), at 7.30.—Short Papers.
BATLEY AND DISTRICT TEXTILE SOCIETY (at Batley Technical College), at 7.30.—Celanese: its Manufacture, Properties, and Uses (Lecture).
OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—O. G. Hay: The Ross Modification of the Hilger Interferometers for Testing Large Optical Elements.—J. S. Preston: The Reflection Factor of Magnesium Oxide.—*Exhibits and Demonstrations*.—Raphael's Ltd.: Scientype Occluding Glass for Use in the Treatment of Squint. A Visual Test with a New System of Equi-photic Illumination.
CHEMICAL SOCIETY, at 8.—C. E. Coulthard, J. Marshall, and Prof. F. L. Pyman: The Variation of Phenol Coefficients in Homologous Series of Phenols.
ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE, at 8.15.—Prof. Kuczynski: The Etiology of Yellow Fever with Special Reference to the Etiology of other Insect Borne Diseases.
BRITISH INSTITUTE OF RADIOLOGY, at 8.30.
ROYAL AERONAUTICAL SOCIETY (Yeovil Branch) (at Yeovil).—Wireless Apparatus for Aircraft.
SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (jointly with Institution of the Rubber Industry) (at 39 Elmbank Crescent, Glasgow).—W. A. Williams: Electro-deposition of Rubber.
TODMORDEN TEXTILE SOCIETY (at Todmorden).—R. Holt: Defects in Yarn and how to avoid them.

FRIDAY, JANUARY 17.

ROYAL SOCIETY OF MEDICINE (Balneology Section), at 5.—Dr. V. Coates: Tissue Reaction in Rheumatic Disorders with Particular Reference to Subcutaneous Nodules.
BRITISH INSTITUTE OF RADIOLOGY, at 5.—Radiology in Bone and Joint Disease.
SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6.—Prof. E. C. C. Baly: The Activated Sludge Process for Sewage Disposal.
INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—T. Walley: The Pooling of Experience a Function of the Institution.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7.—J. D. Johnston: Photographic Conventions.
JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—G. Andrew Marshall: London's Water Supply.
SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester).

SATURDAY, JANUARY 18.

NELSON TEXTILE SOCIETY (at Preston Technical School).—C. A. Harrington: Designing of Fancy Fabrics.
PHYSIOLOGICAL SOCIETY (at King's College).

PUBLIC LECTURES.

MONDAY, JANUARY 13.

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—W. S. Mansfield: Systems of Cropping to meet Modern Conditions.

TUESDAY, JANUARY 14.

GRESHAM COLLEGE, at 6.—A. R. Hinks: Universe Studies: The Massive Centre of the Galaxy. (Succeeding Lectures on Jan. 15, 16, and 17.)

WEDNESDAY, JANUARY 15.

ROYAL ANTHROPOLOGICAL INSTITUTE (at Portland Hall, Great Portland Street Extension of Regent Street Polytechnic), at 5.30.—M. C. Burkitt: Most Primitive Art.

THURSDAY, JANUARY 16.

KING'S COLLEGE, at 5.30.—Lieut.-Gen. H. B. Fawcus: The Royal Army Medical Corps.

SATURDAY, JANUARY 18, 1930

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Editorial and Publishing Offices

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No 3142, Vol 125]

Science and History[1]

"WHAT is the use of historical knowledge ? " asked the late Frederic Harrison when beginning a lecture on the use of history, delivered in London some seventy years ago ' Is an acquaintance with the events, the men, the ideas of the past of any real use in these days ? " To such questions, he remarked that two very different answers might be given, one by the Gradgrinds who would say that it was of no use at all, and the other by the literary gossip who would say history had fifty uses With neither of these did Harrison agree, but running through his lecture was the thought that ' the proper study of mankind is man " No matter whether it be politics, religion, law, literature, science or art, whatever our system of education included, whilst man was wanting all the rest remained vague and incomplete, and aim less ' But the moment we learn the influence which some great discovery has had on the destinies of man the moment we note how all human thought was lighted up when Galileo said that the sun, and not the earth, was the centre of the world, the moment we feel that the demonstrations of Euclid are things in which all human minds must agree—indeed, are almost the only things in which all do agree—that moment the science has a meaning, and a clue and a plan "

It may perhaps be considered not a little surprising to find Harrison so long ago emphasising his view by a reference to science, for although, as Dr Singer recently reminded us, during the last few centuries no event has wrought so fundamental a change as the advent of the scientific way of thinking, there are yet professional historians who are content to tell the political history of the last three hundred years without reference to scientific discovery, scientific method, or the application of science to life and thought, showing a lamentable separation of humanistic from scientific studies This divorcement is no doubt partly due to the comparatively recent growth and spread of the scientific spirit and also to the highly technical character of scientific studies It may be, too, that teachers of science have made no greater attempt to connect science with the humanities than teachers of history to allow for the influences of science

However this may be, whether or no teachers should regard it a duty to connect scientific and historical studies, there can be no question that

[1] A History of Physics in its Elementary Branches including the Evolution of Physical Laboratories By Prof Florian Cajori Revised and enlarged edition, Pp xiii+424 (New York The Macmillan Co, 1929) 15s net

students of science should be familiar with the great pioneers as well as with their discoveries In the past there have been histories of mathematics, astronomy, electricity, and chemistry, and the names of Bossut, Montucla, Bailly, Priestley, Whewell, Grant, Clerke, and Thorpe recall some of the best known of historians of science, among whom Prof Florian Cajori of California holds a distinguished place His "History of Physics" has for long been familiar, and the new edition supplies the need of an up to date review of the subject First published in 1898, the book now runs to more than four hundred pages, and in these are surveyed the science of the ancients and the Renaissance and of the succeeding centuries In the review of the work of the twentieth century are sections devoted to radioactivity and the evolution of physical laboratories

"This is essentially an age", said Sir Ernest Rutherford recently, 'of pioneer activity based on the four great discoveries of X rays, radioactivity, the electron and the quantum theory", and it is just these things Prof Cajori deals with in the new section of his book

If the first steps towards the revival of scientific studies were taken in the fifteenth and sixteenth centuries, experimental science, thanks to the work of Gilbert, Galileo, Huygens, Newton, and others, made its first great onward stride in the seventeenth century It then passed through what has been called the materialistic age of the eighteenth century to the nineteenth, which brought with it law and order Last century Prof Cajori calls a century of correlation, the present is an age of fundamentalism

"The nineteenth century physicist was like the explorer who, reaching Niagara Falls, contemplated with intellectual satisfaction the grand display of natural phenomena before him The twentieth century physicist is like the explorer who, going further, arrived at Yellowstone Park and was perplexed by the endeavour to reconcile the fact that in that region not only does water *fall*, but also *rises* and shoots on high, not steadily but in intermittent streams"

All the hypotheses, all the mysteries of to day, however, we like to believe will eventually lead "to harmonious co ordination, to the old Pythagorean ideal of the 'harmony of the spheres'" The story Prof Cajori unfolds recalls some of the greatest achievements of the human intellect With profound speculation have been joined brilliant efforts of the imagination, patient study of facts, striking examples of manipulative dexterity, and a love of truth The unravelling of the secrets of Nature has been almost entirely the work of the peoples of western Europe, but the benefits are available for the whole world Modern communication and transport, the multiplication of industries and manufactures, the enlargement of the opportunities, and the amelioration of the lot of untold millions, what are they but the material gains due to the attempts to read some of the riddles of the universe? The greatest good derived from them, however, has been the emancipation of the spirit of man from credulity and superstition That is one of the lessons of history

Mathematical Notation

A History of Mathematical Notations By Prof Florian Cajori Vol 2 *Notations Mainly in Higher Mathematics* Pp xvii + 367 (London and Chicago The Open Court Co, 1929) 25*s* net

THE first volume of this invaluable work was noticed in our columns on July 6, 1929, p 4 The vast quantity of material which had to be digested constrained the author to divide it into two volumes, the first of which dealt with notations in elementary mathematics Had it been possible for one man to set forth the rest of the subject down to the present time on the same scale as the part of it included in the first volume, it would have required more volumes still The author has therefore limited himself to "the endeavor to present in the two volumes of this history a fairly complete list of the symbols of mathematics down to the beginning of the nineteenth century, and a fairly representative selection of the symbols occurring in recent literature in pure mathematics" As it is, Prof Cajori has accomplished a great work, for which mathematicians cannot be too grateful to him

The present volume is in four main sections 1 Topical survey of symbols in arithmetic and algebra (advanced part), 2 Symbols in modern analysis, 3 Symbols in geometry (advanced part), 4 The teachings of history The first section treats of letters representing magnitudes, the letters π and e, the evolution of the dollar sign, signs in the theory of numbers, signs for infinity and transfinite numbers, continued fractions and infinite series, signs in the theory of combinations, signs for determinants and logarithms, signs in theoretical arithmetic, and symbolism for imaginaries and vector analysis The second section deals with trigonometrical notations, symbols used in the differential and integral calculus, finite differences, the theory of functions, and finally in mathematical logic down to White

head and Russell. Section 3 covers the recent geometry of the triangle and circle, and projective and analytical geometry. Section 4 may be said to contain the moral of the story. It comprises quotations giving the individual judgments of eminent mathematicians, such as De Morgan, Maclaurin, Babbage, Mach, P. G. Tait, Glaisher, Whitehead, and H. F. Baker, on the interpretation of the history of the subject. Next come empirical generalisations by the author himself on the growth of mathematical notations, followed by suggestions for international co-operation as the only hope for the establishment of uniformity of notations.

When there is such a wealth of interest in the volume before us, it is difficult to make a selection of topics suitable for mention in a notice of this kind. One thing that stands out is the leading part played by Leibniz in the development of mathematical notations. Recognising the supreme importance of satisfactory symbols, Leibniz made a prolonged study of matters of notation, and, unlike others, for example, Oughtred and Hérigone, who launched 'off their own bat' a vast quantity of new signs, he first experimented with symbols for some thirty years, corresponded with mathematicians on the subject, and tried to ascertain their preferences, in order to secure, if possible, an agreed system. He was never better inspired than when he put forward his dx and dy in differential calculus and his sign $\int$ for integration. Yet he withheld the former from print for about ten years, and consulted in the meantime with Oldenburgh and Tschirnhausen. He discussed with Johann Bernoulli both the name and the principal symbol of the integral calculus. Leibniz himself favoured the name "calculus summatorius" and the symbol $\int$, Bernoulli the name "calculus integralis" and the capital letter I for the sign. The result was the happy compromise of adopting Bernoulli's name and Leibniz's symbol.

Nothing better attests the success of Leibniz's careful method of preliminary experimentation and consultation than the fact that no other mathematician has advanced so many symbols which have retained their place to the present day as did Leibniz. The tables which Prof. Cajori gives of the symbols used by Leibniz from time to time in his MSS. and printed papers occupy about nine pages. Leibniz's ideals for mathematical notation were part of his broader scheme of mathematical logic, which, however, was rather a programme than an actual accomplishment. He came to regard logic as "like a universal mathematics", and advocated a "universal language" or "calculus". "This true method", he said, "should furnish us with an Ariadne's thread, that is to say, with a certain sensible and palpable medium, which will guide the mind as do the lines drawn in geometry and the formulas for operations which are laid down for the learner in arithmetic." He prophesied the triumphant success of researches in this field in the famous sentence: 'I dare say that this is the last effort of the human mind, and, when this project shall have been carried out, all that men will have to do will be to be happy, since they will have an instrument that will serve to exalt the intellect not less than the telescope serves to perfect their vision."

Two interesting details may be added. The sign π for the ratio of the length of the circumference of a circle to that of its diameter was first used by William Jones in his "Synopsis palmariorum matheseos" (1706), without any advertisement, or any idea that he was doing anything noteworthy. William Oughtred had so early as 1647 used π/δ for the ratio, where π clearly stood for periphery ($\pi\varepsilon\rho\iota\varphi\acute{\varepsilon}\rho\varepsilon\iota\alpha$). Similarly, Jones, on p. 243, wrote "Periphery (π)", but twenty pages later he quotes an infinite series given to him by John Machin and adds simply "$= 3{\cdot}14159$, etc. $= \pi$."

The old sign for 'factorial n' (two lines forming a right angle), which was used by Todhunter and others in algebraical text-books, was due to the Rev. Thomas Jarrett (1805–1882), of St. Catherine's College, Cambridge, who must have been a remarkable man. Seventh Classic and thirty-fourth Wrangler in 1827, Jarrett made an extensive study of algebraic notation, which he discussed in an article of 1830 and much more fully (1831) in "An Essay on Algebraic Development containing the Principal Expansions in Common Algebra, in the Differential and Integral Calculus and in the Calculus of Finite Differences"; he was professor of Arabic in the University of Cambridge from 1831 until 1854 and Regius professor of Hebrew from 1854 until 1882, while in 1875 he edited the Sanskrit text of the Tale of Nala with vocabulary.

It is amusing to find De Morgan condemning the present sign for 'factorial n' in the "Penny Cyclopædia": "Among the worst of barbarisms is that of introducing symbols which are quite new in mathematical, but perfectly understood in common, language. Writers have borrowed from the Germans the abbreviation '$n!$' to signify $1 . 2 . 3 \ldots (n-1)n$, which gives their pages the appearance of expressing surprise that 2, 3, 4, etc., should be found in mathematical results."!

T. L. H.

Bacteriology in Medicine and Public Health

Medical Research Council A System of Bacteriology in relation to Medicine Vol 3 By W Bulloch, P Fildes, A T Glenny, H Henry, R T Hewlett, R A O'Brien, S G Paine, G F Petrie, Muriel Robertson, R St John Brooks, W G Savage, A C Thaysen, H G Thornton, R L Vollum Pp 413 (London H M Stationery Office, 1929) 21s net

THIS "System of Bacteriology" aims at giving a comprehensive survey of our present knowledge of bacteriology, specially in its relation to medical work The first volume of the series to be published gives promise of a very valuable contribution to scientific literature A book of this kind can only be undertaken by a series of authors, and the reviewer is placed in a rather difficult position He can have only a superficial knowledge of many of the articles, and his judgment of the whole work must, to a certain extent, be influenced by the quality of those papers with which he has an intimate knowledge Of the various papers, the three outstanding ones are those of Chaps viii, ix, and x In Chap viii there is a short history of plague by W Bulloch, but the main part of the chapter by G F Petrie is obviously written by a man of wide experience, and a real authority on the subject It deals with all aspects of plague infection—the characters of the bacillus, the problems in plague immunity, the transmission by the rat flea, the natural disease in rodents, and the various forms of plague in man with reference to its pathology, its diagnosis, and treatment It is a very valuable contribution and must be regarded as a standard work on the subject

Chap ix, on the organisms of gas gangrene, by Muriel Robertson, will commend itself to all who have worked on this subject Miss Robertson deals very fully with the characters of the bacteria and their classification, with their pathogenic action in man and in the lower animals, and with their toxins We may not agree with all Miss Robertson's conclusions, but she has done an extremely valuable piece of work, and has brought some order out of what has been practical chaos The part of this chapter on the preparation and testing of toxins and antitoxins, coming with the authority of R A O'Brien, is an addition of considerable value

It is appropriate that Chap x, on *B tetani*, should maintain the standard set by Miss Robertson Fildes, with Bulloch, O'Brien, and Glenny, have given to scientific bacteriologists and medical men in general a very worthy contribution on this important pathogen We commend these two chapters to all workers with the pathogenic anaerobes as the best summarised work which has yet been published on this subject

Of the merits of some of the other chapters we feel very incompetent to judge Chap i, on "The Economic Aspects of Bacteriology", is of considerable interest, and many points of practical importance have been brought out, but some of the descriptions are scrappy and give the impression that there has been very little advance in economic bacteriology One is surprised that no reference is made to the work of Winogradsky on 'retting', which we think is worthy of rather serious consideration On 'Baking' surely some reference should have been made to bacterial troubles other than 'Ropy bread' These are perhaps minor faults in a work which undoubtedly is both interesting and stimulating

Chap ii, "The Bacteriology of Water", is frankly disappointing The author deals with some factors which influence bacterial counts of water, such as storage, the effects of rain, food supply, temperature, etc, but surely the essential factor in determining the significance of counts is a knowledge of the local conditions of supply, the nature of the gathering ground, the situation of the storage areas, and number and efficiency of the filters A reservoir near the seaside may be frequented by gulls, and the *B coli* content there be greater than if the reservoir were in an inland area, but the *coli* contamination would be of little importance None of these points is even mentioned Then, we find no mention of the bacterial growth which occurs in pipes and tunnels, which is such a big economic problem to water engineers, or of the contamination so often found in leather and other washers

In the portion of this chapter dealing with sewage one is surprised to find no reference to the recent work of Wilson and others on the isolation of *B typhosus* and *B paratyphosus* What is given is well done, but the chapter suffers from the sins of omission rather than those of commission

Chap iii, "Bacteriological Aspects of the Dairy Industry", is well written and will be warmly welcomed by all those who are dealing with the bacteriological aspect of our milk supply The subject is not dealt with very fully, but the essential facts are given and are presented by a man who evidently has accurate knowledge of what is needed

Chap IV, "The Bacteriology of Foods", is interesting, but this subject very naturally raises the question of how much value is to be attached to the ordinary bacteriological examination of food stuffs, for example, the standard laid down for the bacteriology of shell fish is excellent, but the working bacteriologist has to deal with the material as collected from stores and shops where they are being sold many hours, or it may be days, after the removal from the beds So with other foods, there are so many factors that come in that each case has to be dealt with on its merits, and individual bacteriologists will disagree as to the importance to be attached to examination of eggs, fruit, vegetables, and even canned foods Public health authorities still lay considerable stress on this work, and Dr Savage has done the work well

Chaps V, VI, and VII have interested us very much They are well written, but as we have only touched the surface of these fields we do not feel competent to assess the value of the work From the authors of these chapters one would expect valuable contributions, and we have little doubt that to workers on these subjects these papers will be welcomed

Chap XI, on *Bacillus botulinus*, is written by Dr Hewlett, with sections by Dr Bulloch and Dr O'Brien Bulloch deals with the history and O'Brien with the large scale production of anti toxin, a subject on which no one is more qualified to speak The general characters of the bacillus, its fermentation reactions, its serology, and the variations in strains and types, are dealt with very fully The manifestations of botulism in animals, the disease in man, the effects of the toxin and the anti toxin, are all discussed Botulism has become more familiar in recent years, but we feel that this paper gives us a very complete and very accurate account not only of the disease, but also of the causal bacillus

Chap XII is simply a collection of material from various authors, with some observations by Dr Savage As we are told that the Salmonella group is to be dealt with in Vol 4, and as botulism has been dealt with in Chap XI, we think it would have been wiser either to have omitted this chapter altogether or to have treated the subject fully In its present condition it is not of great value

Taking the volume as a whole, we cordially congratulate the authors and the editors on the production The book will prove of enormous value to all bacteriological workers, and we hope that the other volumes will reach the same high standard

J M BEATTIE

Gauges and Fine Measurements

Gauges and Fine Measurements By F H Rolt Edited by Sir R T Glazebrook Vol 1 *Standards of Length, Measuring Machines, Comparators* Pp xv + 366 Vol 2 *Limit Gauges, Measuring Instruments, General Methods of Measurement* Pp viii + 357 (London Macmillan and Co, Ltd, 1929) 42*s* net

IT is questionable if any section of engineering has hitherto suffered so much as the metrological from the want of a standard text book, and now, with the advent of this work, it is just as questionable if any section is better equipped with a really sound and comprehensive treatise The copious references at the end of each chapter show that much of a specialised nature has been written on metrology, but very few indeed of the many engaged on, or interested in, this branch of engineering have more than a fragmentary knowledge of the subject, and the number of persons who could deal with the whole field with the intimate knowledge of the expert is probably exceedingly small It is therefore fortunate that one of the few has produced this treatise

The history of the subject, as revealed more or less incidentally in the two volumes before us, shows that gauge construction and fine measurement was developing so continuously during the last twenty years that probably no particular time during that period would appear appropriate for writing a comprehensive book on the subject During the period 1840–80, Sir Joseph Whitworth introduced his famous system of end gauges, the first end measuring machine, and his system of producing truly flat surfaces by lapping a set of three plates The next important improvement was the introduction of the now common system of 'go' and 'not go' gauges With the exception of Michelson's classical experiment in 1892–93 on the determination of the length of the standard metre in wave lengths of monochromatic light, no further notable contribution to the art appears to have been made until the Johannsson (Swedish) Company introduced its block gauge and slip gauge system in 1908 This appears to have been the starting point of the great advances made since then These gauges opened a new field in the art of mechanical measurement, but, in the workshop, they were regarded as an expensive novelty and tardily adopted until, in 1917, a system of manufacturing gauges of this type was evolved in Great Britain, since when they have been produced in bulk for use in the tool room The degree of

accuracy attained in block gauges is exceedingly high, and the Johannsson gauges are supplied in four grades, respectively accurate to 2, 4, 8, and 12 parts in a million on the length of the gauge

The commencing point in the production of accurate length gauges is the legal standard of length, which is the distance between two parallel lines engraved on a metal bar Comparison between line standards is made with a pair of microscopes, under which the bars are placed in turn and the longitudinal position of the microscopes adjusted by a micrometer to bring them over the lines The adjustment necessary between the settings is a measure of the difference between the standards Yard or metre bars having well defined lines can be compared in this manner to an accuracy of one part in ten million, about 0 000,004 in

Comparing the absolute length of an end gauge with a line standard involves the problem of transference of size from lines to transverse faces A method of wringing on each end of the gauge a short auxiliary block, with a transverse line engraved on it, has enabled this to be effected to an absolute accuracy of one part in two million An end gauge of the standard yard or metre having been obtained, the gauges of shorter lengths are produced by a system of subdivision, making sets of gauges of equal length which together equal the standard In producing these sets a comparator is used which detects a difference of one millionth of an inch The accuracy of the finished gauges is checked by comparing various combinations giving nominally equal lengths, taking into account the thicknesses of the wringing films

The methods of measuring absolute length and making comparisons between end gauges by optical interference methods are exceedingly interesting, and the accuracy attainable is of the order of a fraction of a millionth of an inch The optical interference method is also adopted for testing the flatness of surfaces and for determining coefficients of expansion, but for measuring long gauges it is doubtful if it is more accurate than the mechanical method A further method which will give a natural control on standards of length in terms of time is being developed at the National Physical Laboratory

It is not to be gathered that attention is confined in Mr Rolt's work to these highly sensitive methods of measurement As an example, a system of sets of gauges is described for workshop, inspection, check and standard use, and, in the order given, each is ten times as accurate as the preceding set But these very accurate measurements of standards, etc, are the bedrock on which most of the many developments are based So much ground is covered that it is impracticable to refer in particular to the many instruments, machines, methods, etc, which are described, but it seems certain that nothing of value has escaped attention, and all are treated with the same thoroughness

In practical worth to those concerned in its subject, this work is a most valuable contribution to engineering literature It is very regrettable that circumstances have postponed the publication of the third volume dealing with screw threads, and its appearance will be looked forward to by all readers of the present two volumes

L M D

The Extinct Dwarf Elephants of Sicily and Malta

Les elephants nains des îles méditerraneennes et la question des isthmes pleistocènes Par Raymond Vaufrey (Archives de l'Institut de Paleontologie humaine, Memoire 6) Pp ii + 220 + 9 planches (Paris Masson et Cie, 1929) 160 francs

IT may seem strange to find a memoir on extinct dwarf elephants among the publications of the Institute of Human Palæontology These elephants, however, lived on several islands in the Mediterranean during part of the period when Palæolithic man ranged over both western Europe and northern Africa They were especially abundant in Sicily and Malta, where they are commonly supposed to have been stranded when a neck of land which connected Italy with Tunis became submerged, except in the fragments which those islands represent The proper understanding of them, therefore, has an important bearing on the geography of the Mediterranean region in Pleistocene times when early human migrations were taking place

Dr Raymond Vaufrey has studied the subject as thoroughly as possible, both by examining the collections of remains of dwarf elephants which have already been made, and by visiting the various caves and rock fissures in Sicily and Malta in which these fossils occur He himself has also made an important contribution to knowledge by providing new material to distinguish precisely the smallest form of dwarf elephant, commonly known as *Elephas falconeri*, from the somewhat larger form, *E melitensis* In the cave of Luparello, near Palermo, he found two superposed deposits, the upper containing only *E falconeri*, the

lower only *E melitensis*, so that there could be no confusion of the teeth and bones of the two forms He showed at the same time what had long been suspected, that the smaller form was of later date than the larger form

The technical descriptions of the teeth and bones are illustrated both by diagrammatic text figures and by several plates of most beautiful photographs The results are then summarised, and it seems clear that the dwarf elephants both of Malta and Sicily represent three distinct races of the well known European Pleistocene *Elephas antiquus*, as already recognised by Pohlig, with no relationship to the modern African elephant They must all have had a comparatively large head, for the size of the molar teeth is less reduced than that of the limb bones The largest members of the race *falconeri* would be less than a metre in height, those of the race *melitensis* would stand about 1 40 m high, and those of the race *mnaidriensis* about 1 90 m high As teeth of *E antiquus* of normal size have already been found in the oldest Pleistocene deposits of Sicily, and as the deposits in the caves are evidently of later date, the dwarfing must have occurred after the beginning of the Pleistocene period

To determine the exact date of the dwarfing of the elephants, Dr Vaufrey has made many important geological observations, and has searched especially for evidence of associated man He has not found any implements in the same deposits as the teeth and bones, and he is satisfied that the two human teeth discovered some years ago in the Har Dalam cave of Malta are neither Mousterian (as often claimed) nor from the elephant bearing layer He has found stone implements of very late Palæolithic type only in certain caves in Sicily well above the deposits containing remains of dwarf elephants He therefore concludes that Palæolithic man did not reach the Sicily Malta land area until after the elephants had become extinct They probably flourished in Mousterian times

In conclusion, Dr Vaufrey compares the Sicilian and Maltese fossils with the corresponding remains of dwarf elephants found by Miss Dorothea Bate in Cyprus and Crete, and by Dr Forsyth Major in Sardinia He considers that the remains from Cyprus belong to the races named *falconeri* and *melitensis*, while all those from Crete and Sardinia represent the race *melitensis* As Cyprus, Crete, and Sardinia can scarcely have been continuous with Sicily and Malta after the early part of the Pleistocene period, similar dwarf races must have arisen independently from *Elephas antiquus* in at least four areas

The dwarf elephants of the Mediterranean islands, therefore, must be regarded as the stranded descendants of a well known early Pleistocene European species which roamed over the Mediterranean lands before parts were broken up into islands As no distinctively African animals are represented by fossils in the same deposits as their remains, and as the dwarf elephants are not closely related to the modern African elephant, the Sicily Malta land area cannot ever have extended to Tunis During Pleistocene times, indeed, there was no land bridge in this region which man could traverse between the European and African continents A S W

Our Bookshelf

Surveying as Practised by Civil Engineers and Surveyors, including the Setting Out of Works for Construction and Surveys Abroad, with Examples taken from Actual Practice, intended as a Handbook for Field and Office Use, also as a Text Book for Students By John Whitelaw, Jun Eighth edition, thoroughly revised and enlarged by Col Sir Gordon Risley Hearn Pp xvi + 578 (London Crosby Lockwood and Son, 1929) 16s net

HAVING achieved in the past the distinction of appearing in seven editions, Whitelaw's "Surveying" has now, in the capable hands of Col Sir G R Hearn, been thoroughly revised and enlarged in accordance with the most recent developments in modern practice and issued in its eighth form Originally designed as a compact handbook, it has now become somewhat too bulky literally to fulfil such a function, but as a desk manual and a comprehensive text book for students it will command an even wider range of utility and service

In the new edition prominence is rightly given to developments in the field of tacheometry or stadia surveying, and to other means of rapid measurement required in modern prospective work and for kindred purposes, in which the plane table and aneroid barometer also find a field of usefulness Photographic and aerial surveying similarly receive notice Attention, moreover, is directed to modern instruments of precision, and a description is given of the micrometer microscope

To those who are not familiar with the scope of the work, especially in its enlarged form, the following summary of the contents of the successive chapters may be useful surveying by means of the chain only, surveying with the aid of angular instruments, levelling operations, adjustment of instruments, railway and road surveys, tacheometric surveying, tunnel work, water supply surveys, hydrographical surveying, astronomical observations connected with surveying, surveys abroad in jungle, desert, and

unmapped open country, and trigonometrical or geodetic surveys An appendix adds a number of useful details on various points, including plan preparation and photographic reproduction There is a serviceable index B C

Bahnbestimmung der Planeten und Kometen Von Prof Dr G Stracke Pp viii + 365 (Berlin Julius Springer, 1929) 26 gold marks

THIS is a volume of convenient size, and gives in a compact form all the details of orbit computation Dr Stracke has great experience in such computations from his extensive work on minor planet orbits for the Berlin Rechen Institut The first chapter gives a description of undisturbed motion about the sun, and the relation of the geocentric to the heliocentric places The next gives the various reductions that the observed positions need before commencing the orbit computation The third chapter is the fundamental one, it describes three different methods of deducing an elliptical orbit from three observations, and two of doing so from four observations, then follow two methods for a circular orbit, and two for a parabolic one, it is to be regretted that Leuschner's method is not included, as many computers prefer it to any other, and it is very effectively employed in America The next chapter explains the calculation of ephemerides, including all the refinements necessary when exact ones are required

The chapter on perturbations describes the methods of Cowell and Numerow, in which the co ordinates x, y, z are determined by mechanical quadratures, also that of Encke, in which the perturbations of x, y, z are thus calculated Lastly, there is a chapter on the improvement of orbits by the inclusion of later observations

There are numerous examples, the elliptical orbit of planet No 996 is worked out from an arc of 50 days, and a parabolic orbit is found for Orkisz's comet from an arc of a month There is a collection of tables at the end of the volume and also an extensive list of books and pamphlets relating to the subject The very useful X, Y tables of Innes, published since the list was prepared, should be added to it A C D C

Ur of the Chaldees a Record of Seven Years of Excavation By C Leonard Woolley Pp 210 + 16 plates (London Ernest Benn, Ltd, 1929) 7*s* 6*d* net

MR WOOLLEY'S brief but compendious account of the excavations at Ur during the seven seasons in which he has been in charge of the joint expedition of the British Museum and the Museum of the University of Pennsylvania, is both timely and convenient Periodical reports and newspaper articles freely contributed to the Press by Mr Woolley have kept his public informed of the progress of the work in each season, but everyone will be glad to have at hand this convenient summary of the results as a whole

Reading through Mr Woolley's narrative in this connected form, and surveying his material as it is possible to do here, only serves to bring home with telling force the importance of this work for the history of civilisation During the past two seasons, apart from the evidence for a flood of unexpected dimensions, of which the interest will vary according as it is taken to bear upon Biblical narrative, the excavation of the Royal and 'private' tombs, with their rich treasure and elaborate offerings of human and animal victims, has thrown an entirely new light upon ritual and culture in Sumeria at this early stage It has given us a new view of the artistic achievements of the early Sumerians for which even the discoveries of previous seasons at El Ubaid and Ur itself had not prepared us By the side of these achievements, the excavation of the great temple at Ur seems to pale in interest, but Mr Woolley's account of this remarkable piece of work will serve to restore something of a sense of proportion

Physical Chemistry By Dr J B Firth Pp iv + 292 (London University Tutorial Press, Ltd, 1929) 5*s* 6*d*

DR FIRTH has undertaken a difficult task in attempting to outline the modern doctrines of physical chemistry in a book of less than 300 pages This task has been rendered more difficult by the inclusion of an introductory chapter on the atomic and molecular theories and a final chapter on atomic structure The author has therefore summarised the subject matter of the usual elementary course of physical chemistry within the narrow limits of about 240 pages, but has done his work so well that no important omissions appear to have been made Of up to date topics the use of the parachor is briefly but adequately described, but the modern theory of complete ionisation of strong electrolytes is only referred to in a footnote which states that "the assumption that the speed of the ions remains unaltered on dilution holds for weak electrolytes but not for strong electrolytes" The text includes some 50 figures and a collection of 106 problems and test questions

The Rise of Modern Physics a Popular Sketch By Prof Henry Crew Pp xv + 356 + 24 plates (London Baillière, Tindall and Cox, 1928)

FOR many years Prof Crew has been lecturing to students of Northwestern University (in Evanston, a suburb of Chicago) on the history of science He has now put his lecture notes into book form, so that they may benefit a wider circle His book is not intended to be a serious critical study of the history of physics, but rather an outline that will enable the modern student to appreciate the labours of the pioneers of the science This object it achieves admirably It may occasion surprise to find that Galileo receives much more attention than does Newton, but this is probably due to the fact that the author had previously made and published an intensive study of the life of Galileo

The book is lucidly written and may be perused with profit by all students of physics, and indeed by all whose interest is in the domain of science L J C

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

Loss of Ultra-Violet Transparency in Glasses

IN a recent issue of NATURE (Sept 21, 1929, p 441) Messrs Wood and Leathwood described some experimental work on the ageing or solarisation of ultra violet transparent glasses, from the results of which they arrived at two conclusions (1) that complete degeneration by a mercury arc lamp results in a greater loss of ultra violet transparency than does natural solarisation, and (2) that natural solarisation of U V glasses is complete after only a few days' exposure to the sun

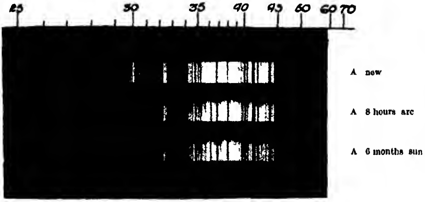

FIG 1 —Natural and artificial ageing of glass 'A';

The first of these conclusions is a confirmation of observations published by me in a paper in *Glass* (September 1928) in which it was shown that only eight hours' treatment with a mercury arc lamp was sufficient to reduce the ultra violet transparency of four different types of glass to the same extent as six months' exposure to the sun and a practically complete hemisphere of sky Throughout the whole of the comparisons of natural and artificial ageing described in that paper, a standard period of eight hours' arc treatment was adopted, although prior to that date all the test reports given by the National Physical Laboratory and by the Reichsanstalt of which I was cognisant, showed that artificial ageing had been carried out by mercury arc lamps for periods of twenty four hours The similarity of the effect of six months' natural solarisation and eight hours' artificial ageing on one particular glass (glass 'A') is clearly shown in Fig 1

Among the data given by Wood and Leathwood an interesting fact is given but not emphasised, namely, that all glasses are not equally susceptible to this loss of ultra violet transparency This can best be brought out by photographs taken, developed, and printed under identical conditions, rather than by quoting figures Pieces of two glasses ('A' and 'H') of similar thickness but different manufacture were cut into three sections One section of each was preserved in the 'new' condition, the other two were simultaneously subjected respectively to five hours' and ten hours' artificial ageing, six inches below a quartz mercury lamp Afterwards, photospectrographs of the transmission of each of the six sections were taken on one plate, using an iron arc and giving a uniform twenty seconds' exposure in each case

The results, reproduced in Fig 2, clearly show that even this severe treatment barely affects the glass 'H', but, on the other hand, the glass 'A' suffers a serious reduction in ultra violet transparency when judged either by the extent of the transmission or by the brightness in the important zone between 2950 A and 3200 A These observations have recently been confirmed by National Physical Laboratory tests on a sample of the glass 'H' (independently selected by a well known London architect) and on a piece of the glass 'A' bought in the ordinary way of business These tests show that at 3050 A the glass 'H' has an initial transparency of 68 per cent, falling to 53 per cent on arc ageing, while the glass 'A' has an initial transparency of 64 per cent, falling to 45 per cent on arc ageing Natural solarisation shows up the difference between these two glasses even more clearly

Turning now to the second conclusion arrived at by Wood and Leathwood, namely, that natural solarisation is complete in comparatively few days

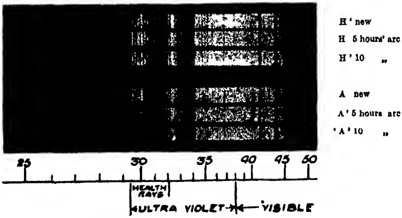

FIG 2 —Comparative artificial ageing of glasses 'H and 'A

This is contrary to my experience and to that of independent investigators who have made a detailed study of the subject, as shown by the following data At the beginning of last January I took pieces of five types of ultra violet glass, each cut into a number of sections One section of each was preserved in its new condition, the others were exposed in a horizontal roof for periods of 1, 2, 3, 6, and 10 months, after which period, photographs of their transmissions were taken Since a glass 'S' shows this solarisation effect better than most of the others and much more pronouncedly than the glass 'H', its transmission photograph is reproduced to illustrate

the results (Fig 3) This photograph clearly shows that, though the first month's exposure is most effective, the loss of transparency proceeds to a marked extent during the second and third months, and at a slower rate even up to six months There appears to be no appreciable change after the lapse of six months—as shown by the transmission of the samples exposed for six and ten months In considering these results it must be remembered that the first three months of exposure were comparatively sunless winter months, while the later months were particularly bright and sunny

Coblentz and Stair, in a recent paper from the Bureau of Standards, show that a sample of an ultra violet glass, exposed at Washington from October

Iron arc
New
1 month s sun
2 months sun
3 „
6
10 ,

FIG 3 —Natural solarisation of glass S'

1927 to June 1928, suffered a reduction of transparency from an initial value of 55 per cent at 3020 A to 48 per cent after one month, to 47 per cent after three months, to 45 per cent after six months, and to 43 per cent after nine months They express the opinion that this photochemical change may require several years' exposure to the sun before a state of perfect stabilisation is reached Whether this is a too pessimistic view or not, the photograph reproduced in Fig 3 and the general results obtained by Coblentz and Stair show conclusively that, though the greatest loss of transparency occurs during the first few weeks of exposure to the sun, this deterioration is not generally complete until after the lapse of six months

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Optical Superposition among Menthylamines and Menthols

THE following relative molecular configurations have recently been advanced for the four possible series of stereoisomeric menthylamines, all of which are now known (*Jour Chem Soc*, p 2170, 1927)

Me | H	Me | H	Me | H	Me | H	(1)
H | NH_2	NH_2 | H	NH_2 | H	H | NH_2	(3)
H | Prβ	H | Prβ	Prβ | H	Prβ | H	(4)
l Menthylamine	*d neo*	*d-iso-*	*d-neoiso*	

The respective values of $[\alpha]_D$ (in chloroform) for the acetyl derivatives are − 81 7°, + 53 0°, + 30 7°, and − 2 6° The sum of any two of these values is approximately equal in magnitude and opposite in sign to the sum of the other two, and from a series of observations which we have just concluded upon 14 other derivatives of each base we find that this curious relationship holds generally for menthylamine derivatives of the type R CH_2 CO NH R', and for the free bases, it obtains, moreover, for $[\alpha]_{5461}$, as well as for $[\alpha]_D$ When R is phenyl and the adjacent methylene group is simultaneously eliminated, the relationship fails, nor is it evident in derivatives of the type R CH NR'

Upon selecting a suitable derivative, for example, the acetyl derivative, and superposing the four configurations shown above, it is found that the algebraic sum of the four values of $[\alpha]_D$ approximates to zero In the process of superposition, the optical effects of the asymmetric groups (3) and (4) would appear to undergo a mutual neutralisation, owing to the opposed spatial dispositions of these groups in the various molecules The possibility of such an annulment is not immediately obvious, however, for the asymmetric group (1), which has the same spatial disposition (that is, Me | H) in all four configurations Unless the approach to a zero value is purely fortuitous, which appears improbable, a simple explanation may be sought in the assumption that the asymmetric group (1) exerts a numerically constant rotational effect in all four configurations, the positive or negative sense of which is determined by the nature of the attached complex group (*vide infra*) If, in two of the four instances, the effect is negative, and in the other two positive, the origin of the zero value is explained

By taking the mean optical rotation of the *l* and *d iso* acetyl derivatives, the rotational effect of the asymmetric group (1) is evaluated at 25 5 units, and the mean optical rotation of the *d neo* and *d neoiso* acetyl derivatives gives the almost identical result 25 2 units the average value is thus 25 4 units Similarly, the average value for the combined rotational effect of the remaining asymmetric centres, (3) and (4), is 56 2 units for *cis* H and 27 8 units for *trans* H

Proceeding now to a generalisation, it seems that in each of the eight stereoisomeric acetylmenthyl amines the asymmetric group (1) has a constant value of 25 4 units of specific rotational power (in chloroform solution, for sodium light) When the configuration Me | H is attached to $\begin{array}{c|c} H & NHAc \\ H & Pr\beta \end{array}$ or to $\begin{array}{c|c} NHAc & H \\ Pr\beta & H \end{array}$ it exerts a lævo rotatory effect, but when the same configuration is attached to $\begin{array}{c|c} H & NHAc \\ Pr\beta & H \end{array}$ or to $\begin{array}{c|c} NHAc & H \\ H & Pr\beta \end{array}$ its effect, although equal in magnitude, is dextro rotatory Further, the complex asymmetric groups $\begin{array}{c|c} H & NHAc \\ H & Pr\beta \end{array}$ and $\begin{array}{c|c} H & NHAc \\ Pr\beta & H \end{array}$ have respective constant values of − 56 2 and − 27 8 units of specific rotational power From the three constants, 25 4, 56 2, and 27 8, it is possible to calculate the value of $[\alpha]_D$ for any acetyl menthylamine the relative molecular configuration of which is known A similar statement applies to any menthylamine derivative of the type R CH_2 CO NHR' which we have examined up to the present As an illustrative example, the configuration of acetyl *d* menthylamine may be selected $\begin{array}{c|c} H & Me \\ NHAc & H \\ Pr\beta & H \end{array}$ The complex configurational unit $\begin{array}{c|c} NHAc & H \\ Pr\beta & H \end{array}$ has the value + 56 2, Me | H attached to it has the value − 25 4, so that obviously the value for H | Me is + 25 4 Thus, $[\alpha]_D$ for acetyl *d* menthylamine is 56 2 + 25 4 = + 81 6

It appears, then, that the magnitude of the optical

effect of the asymmetric group (1) is retained throughout the various stereoisomeric forms, independently of the other two asymmetric groups which are present. No corresponding constancy can be postulated, however, for either of the asymmetric groups (3) or (4), taken separately. A marked discrepancy is noticed when the rotational effect of either of them is calculated in two ways. Thus, the optical effects of the asymmetric groups (3) and (4) appear to undergo striking fluctuations, determined by their immediate environment in the molecule. The apparent constancy of the optical effect of the asymmetric group (1) may perhaps be correlated with the fact that there is no alteration in its immediate environment when it is rotated through an angle of 180°.

It will be of particular interest to conduct similar investigations with the menthols and their derivatives, when the complete series eventually becomes accessible. Meanwhile, a close parallelism is discernible between the optical rotations of the menthylamines and the corresponding menthols, so far as the latter are known. The following comparison of values of $[\alpha]_D$ is instructive:

	l	*d neo*	*d iso*	*d neoiso*
Menthylamine (no solvent)	−43·2	+15·1°	+28·8	+0·3°
Menthol (no solvent)	−49·9	+19·6	—	—
Menthol (in alcohol)	−49·1	—	+27·0	?

Unfortunately, the specific rotatory powers of the *neo*menthols appear not to have been observed in alcohol; but from the data available for *l* menthol (Gildemeister, "Die Ätherischen Öle", Leipzig, I 469, 1928), the value may be accepted provisionally as being practically identical with that of the liquid substance. Applying, then, to the specific rotatory powers of the three known series of menthols processes similar to those developed above for the analogous menthylamines, the appended specific rotational values are calculable for the three fundamental asymmetric groups:

SPECIFIC ROTATIONAL VALUES FOR ASYMMETRIC GROUPS IN THE MENTHOLS—$[\alpha]_D$ IN ALCOHOL

Me | H	H | OH / H | Prβ	H | OH / Prβ | H
+11·1	−38·0	−8·5

CORRESPONDING VALUES FOR THE MENTHYLAMINES—NO SOLVENT

+7·5	−36·0	−7·4

The prediction may now be made that the value of $[\alpha]_D$ for the unknown *d neoiso*menthol, having a configuration similar to that of *d neoiso*menthylamine above (*Chemistry and Industry*, p. 878, 1927), will be −8·5 + 11·1 = +2·6°.

It is possible in this place to give only a brief outline of the relationships concerned, and details will be published elsewhere. Further studies of this kind may be expected to throw a good deal of new light upon the so-called principle of optical superposition. The main obstacle to such work lies in the great difficulty of gaining access to complete stereoisomeric series of suitable substances.

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Structural Variation in the Chromosomes of *Campanula persicifolia*.

CHROMOSOME behaviour at meiosis has been described in *Campanula persicifolia* to show the relationships of diploid, triploid, and tetraploid forms.[1] The haploid number is eight. In the diploid, as a rule the chromosomes are associated at both ends forming rings, but occasionally association at one end gives a rod. In the tetraploid, the majority of the chromosomes still associate in pairs, but this is varied by the formation of rings and chains of four as well as by failure of pairing. In the triploid the third chromosome is occasionally associated with its homologues in a chain, but more usually free. The end to end association always found at metaphase follows terminalisation of from two to five interstitial chiasmata found at a diplotene stage characteristic of parasynapsis. This terminalisation accounts for the failure of quadrivalents by the cancellation of chiasmata.[2] We may therefore speak of the chromosomes as being joined at metaphase by terminal chiasmata with an approximate average of two to each chromosome.

FIG. 1.

In plants from two sources anomalous chromosome behaviour has been found at meiosis: (i) a white double variety in cultivation; (ii) a type form found wild at Gmunden, Austria (two seedlings). These have, instead of eight rings of two at metaphase, six rings of two and one group of four which takes the forms shown in Figs. 1 and 2.

The types are given in order of frequency. The last three, in which one of the four chiasmata necessary for

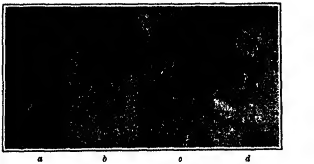

FIG. 2.—Microphotographs of metaphase × ca. 1500. *a*, normal type; *b*–*d*, structural hybrid type. *a*, 8 bivalents; *b*, type I ring; *c*, type III ring; *d*, type IV chain.

a ring may be said to have failed, are in small proportion in the white double and have not been found in the Austrian seedlings. The failure of two or three chiasmata, giving two pairs or actually unpaired chromosomes instead of the ring of four, has been observed occasionally in both forms.

Specific properties of ring formation are inherited. Twenty nine plants were raised from the cross white double by the seedling from Murols (Puy de Dôme). Of four that were examined, three had the ring of four as in the female parent, one had simple pairing (8 bivalents).

The somatic complement has been examined in several stocks (Fig. 3). Some (for example, Murols and Varna) have all chromosomes medianly con-

[1] Gairdner, *Jour. Genet.*, 16, 1926.
[2] Darlington, *Jour. Genet.*, 21, iii, 1929.

stricted, others (for example, Gmunden) have five of the eight pairs with subterminal constrictions. Other more complex structural changes are still under investigation.

It has been suggested that the parasynapsis (side-by-side conjugation) of homologous parts of chromosomes is a universal condition of meiosis [3] and that therefore the association of more than two chromosomes in a diploid must always be due to the interchange of segments between non-homologous chromosomes in the complement of one parent (an explanation already proposed in the case of *Datura* [4]). Such diploid zygotes must be ***structural hybrids***, for they are produced by the union of gametes dissimilar in respect of the structure of their chromosomes. The behaviour of these anomalous forms is in agreement with this hypothesis in the following respects:

(1) The occurrence of interstitial chiasmata at prophase shows that pairing of the chromosomes in *Campanula* is by parasynapsis. The end-to-end pairing is a secondary condition of known origin.

(2) The ring of chromosomes (here, as in *Pisum* [5]) may be represented as consisting of four segments A, B, C, and D occurring as chromosomes AB and CD in the complement derived from one parent, BC and DA in the complement derived from the other. Then, since each of the segments has the specific property of pairing with an identical segment, the only configuration possible will be (i) the ring, and (ii) chains derived from the ring by failure of one or more chiasmata in the ring. Configurations of the X and Y shapes found in tetraploids and depending on the formation of multiple chiasmata between the ends of several segments do not occur.

Murols Gmunden

FIG 3.—×2000

(3) The orientation of the ring when formed is in no way different from that found in *Œnothera* or *Rhœo* [2]. That is to say, apart from the usual segregation of pairing chromosomes to opposite poles, non-disjunction may occur (type III). These variations occur equally in tetraploid *Tradescantia* [3] and *Primula sinensis* (unpublished).

(4) As in the tetraploid form,[1] so with four associated chromosomes in the diploid, failure of pairing sometimes occurs. The regularity of pairing should depend on the length of the segment of chromosome exchanged.[3]

(5) The ring of four in the diploid is more constant than in the tetraploid, because in the absence of competition there can be no cancellation of chiasmata.

(6) As in *Œnothera*, *Rhœo*, and *Datura*, the specific pairing properties of the chromosomes are inherited unchanged.

(7) Different races of *C. persicifolia* have visible structural differences in their chromosomes. Structural variation is a necessary antecedent of structural hybridity, but has not previously been demonstrable in the somatic chromosomes except in a tetraploid, *Tradescantia virginiana*.[2]

On these grounds we conclude that the present observations show in *Campanula persicifolia* the incipient stages of structural hybridity. They provide another valuable link connecting the complex permanent structural hybrids in *Œnothera* and *Rhœo* with everyday homozygous organisms, and thus enable us to regard all types of diploid ring formation as due to a modification of the results of ordinary parasynapsis produced by this condition of structural hybridity.

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[3] Darlington, *Jour. Genet.*, 20, iii and 21, i and ii, 1929.
[4] Belling and Blakeslee, *Proc. Nat. Acad. Sci.*, 12, 1926.
[5] Richardson, *Nature*, 124, Oct. 12, 1929.

Optical Anisotropy and Theoretical Intensities of Raman Lines in Diatomic Gases

WE wish to consider the scattering bound with the vibrational transitions $|\Delta v| = 1, 2$ (Raman lines) and $\Delta v = 0$ (Rayleigh lines). In each case there is a well known [1] selection rule for the rotational transitions $\Delta j = 0, \pm 2$. The plus sign gives rise to a double R branch, the minus sign to a double P branch, and $\Delta j = 0$ to a Q branch. Initial and final states correspond to an electronic ground level $^1\Sigma$.

In the case $\Delta v = 0$, a discussion of the Kramers-Heisenberg dispersion formula leads to the following values for the scattering moment; $M(\pi)$ and $M(\sigma)$ are respectively the components parallel and perpendicular to the electric field E of the plane polarised monochromatic incident light wave. R and P branch, $\Delta v = 0, j \longrightarrow j \pm 2$:

$$M^2(\pi) = E^2\gamma^2\ 2/15\ J(j \pm 1) \quad M^2(\sigma) = E^2\gamma^2\ 1/10\ J(j \pm 1)$$

Q branch, $\Delta v = 0, j \longrightarrow j$:

$$M^2(\pi) = E^2\zeta^2(2j + 1) + E^2\gamma^2 I(j) \quad M^2(\sigma) = E^2\gamma^2\ 1/15\ J(j)$$

where $J(j) = j(j+1)/(2j+1)$. $I(j)$ is a rational function of j which reduces to $2j/45$ for large values of j. ζ and γ are defined as

$$\zeta = (\alpha + 2\beta)/3 \qquad \gamma = \alpha - \beta$$

where, as seen below, the constants α and β represent the influence of the electronic levels only on the intensity of the scattered lines. The relations are sums taken over the $(2j + 1)$ degenerate rotational states.

In the case $v - 1 \rightleftarrows v$, similar expressions are obtained, with the difference, however, that α and β are replaced by $\kappa\alpha'\sqrt{v/2}$ and $\kappa\beta'\sqrt{v/2}$, where $\kappa^2 = \nu_{rot}/\nu_{osc}$ (κ^2 = 1/10 to 1/50; $\nu_{rot} = h/4\pi^2 I$, I moment of inertia; ν_{osc} = frequency of oscillation in the ground level). If $|\Delta v| = n$, the scattering moment is proportional to κ^n and to $\alpha^{(n)}$ or $\beta^{(n)}$.

Denoting by $\alpha(R)$ the electronic polarisability of the molecule along its axis of symmetry, the nuclei being a fixed distance R apart, the following connexion is found for the α's:

$$\alpha(R) = \alpha + \alpha'(R - R_0)/R_0 + \ldots \alpha^{(n)}[(R - R_0)/R_0]^n$$

where R_0 is the nuclear distance in the position of equilibrium of the ground level. Similarly, $\beta(R)$ means the polarisability along any direction perpendicular to the axis. Only matrix elements of electronic transitions from the ground level Σ to any Σ level enter into the expression for α, and to any Π level for β. Both α and β vary slowly with the incident frequency, except in the neighbourhood of an electronic frequency of absorption.

An apparently good check on the formulæ was obtained on comparing with the photographs for gaseous hydrogen made by Rasetti.[2] The formulæ still show that the depolarisation of any line in the

[1] E. C. Kemble and E. Hill, *Proc. N. A. S.*, 15, 387, 1929. F. Rasetti, *ibid.*, 15, 515, 1929.
[2] F. Rasetti, *Phys. Rev.*, 34, 367, 1929.

P- or *R* branch, that is, the ratio of its σ to π components, observed in a direction perpendicular to *E*, *should be the same and equal to 3/4* for *all diatomic molecules*, irrespective of the incident frequency and the temperature

The total intensity of each *unresolved* branch can be calculated For temperatures not too much below the room temperature, the intensity of the *Q* branch remains nearly constant, whereas there is a *dissymmetry* in the intensities of the *P*- and *R* branches, the *R* branch, on the low frequency side, being the stronger the more the temperature is decreased Thus, the total unresolved *P Q R* line should be *diffuse*, with a slight apparent shift of the centre of gravity of the line towards the red This dissymmetry should usually be more pronounced for the σ- than for the π component The effect, which seems to exist in vapours,[3] is, however, insufficient to account for the large frequency shift of the scattered lines towards the red, observed in such liquids as ammonia and hydrogen chloride[4]

Finally, the intensities in the *P* and *R*-branches are proportional to the factor of *optical anisotropy* $\gamma^2 = (\alpha - \beta)^2$, for the intensities vanish when $\alpha = \beta$, that is, when the electronic polarisation is the same in every direction A connexion between diffuseness of the lines and optical anisotropy has been noticed experimentally by Raman[5] A slight dependence on the incident frequency is also to be expected for the anisotropy

The relative scattering intensities of a Rayleigh and the related Raman lines corresponding to transitions from the same vibration level are in the ratios ϵ^2 $(\epsilon')^2\kappa^2$ $(\epsilon'')^2\kappa^4$ where $\epsilon^{(n)}$ means a quantity of the order of magnitude of $\alpha^{(n)}$ and $\beta^{(n)}$ As has been emphasised elsewhere,[6] the presence of the factor κ^2 explains why harmonic Raman lines, when they can be detected, are so faint One must, however, take into consideration the additional influence of the electronic levels, as marked by the ϵ's, which may modify somewhat the expected intensity ratios Moreover, the dependence on the frequency may also not be the same for the different ϵ's, although the trend of variation remains Thus it can be explained why it is that the ratio of intensities of the Raman and Rayleigh lines has not been found to be rigorously independent of the incident frequency[6]

Although the theory has been developed for diatomic molecules, it seems that some of the preceding conclusions can be extended to polyatomic molecules The only assumption made in deducing the above results is that the molecule is stable in the ground state The rapidity of convergence of the expansion for $\alpha(R)$ is immaterial

C MANNEBACK

University of Louvain

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[3] J Cabannes and P Daure, *C R* 186 1533, 1928 A shift of 0 01 A. *for butane vapour at normal pressure*

[4] P Daure Thèse Paris 1928 Shift of 100 cm^{-1} for the 'missing' line in liquid hydrogen chloride and of 20 cm^{-1} for the *Q* branch at 3μ in liquid ammonia.

[5] C V Raman and K S Krishnan, *Proc Roy Soc*, A, 122, 23, 1928

[6] *Naturwiss.*, 17, 364, 1929 Also J H van Vleck, *Proc N A S*, 15, 754, 1929

Intermetallic Compounds in Mercury

ATTENTION has not previously been directed to the possibility of formation of intermetallic compounds (other than with mercury) in liquid mercury It is expected *a priori* that if such compounds are formed they would be unstable With Mr P V F Cazalet I am investigating this problem and our preliminary results are given below

Pairs of metals more reactive than mercury have been obtained in mercury either by direct solution or by electrolysis These mixed amalgams have been subjected to the action of potassium permanganate or other oxidising agents in sulphuric acid solution and the resultant solution of sulphates quantitatively analysed So far, in none of the reactions investigated does mercury itself take part The reactions occurring may be classed under three heads, namely

(1) The more reactive metal is completely removed from the amalgam before the second takes part in the reaction This occurs with cadmium and copper, cadmium and iron, lead and copper, lead and iron, the first named in each case acting as the more reactive metal

(2) The more reactive metal alone takes part in the reaction, then, before it is removed, the second metal begins to take a part which increases until both metals are completely removed from the mercury, at which stage the first is scarcely detectable This occurs with tin and iron

(3) The more reactive metal alone takes part in the reaction until its concentration (in atoms), relative to that of the second metal in the amalgam, is represented by a simple ratio Then, and until both metals are completely removed by the oxidising agent from the amalgam, does the atomic ratio of the metals taking part in the reaction remain simple and constant This occurs with tin and copper, zinc and copper, zinc and iron, copper and iron

These 'constant reducing' mixtures of metals behave in each case like an amalgam containing the less reactive metal, and certainly markedly different from an amalgam of the more reactive metal as regards solubility in mercury, action on acids, and action on certain oxidising agents For example, whereas zinc is soluble in mercury to the extent of about 1 per cent, the zinc copper complex is totally insoluble, whereas zinc in mercury reduces quinquevalent vanadium to the divalent state without difficulty, the zinc copper complex reduces it only to the quadrivalent state Again, whereas tin in mercury (as in the free state), when oxidised by ferric sulphate, pauses in the stannous condition before being oxidised gradually to the stannic condition, the tin copper complex may be shown to be oxidised directly to the stannic condition

The complexes examined tend on standing to dissociate into the more reactive metal, and either the less reactive metal or a similar complex richer in the less reactive metal Vigorous shaking prevents the dissociation or restores the association The empirical formulæ of the complexes so far obtained are $SnCu_2$, $SnCu_3$, $SnCu_4$, $ZnCu$, $ZnFe$, $ZnFe_6$, and $CuFe$ The second and fourth of these are known to metallurgists, and the third may possibly be the known compound Sn_8Cu_{31} Whether these complexes are true compounds, however, must depend upon how accurately their analysis gives a simple ratio of atoms and upon their examination after removal from suspension in mercury

A S RUSSELL

Dr Lee's Laboratory,
Christ Church, Oxford,
Dec 21, 1929

Some Bands of the Carbon Molecule

IN a recent communication (NATURE, Jan 11), Dieke and Holtgreven have given details of a new system of the C_2 molecule The band heads (degraded to the ultra violet) have long been known from the work of Deslandres and D'Azambuja (*vide* Kayser's "Handbuch", vol 5, p 234), while in 1916, Raffety (*Phil Mag*, vol 32, p 546) recorded four of the strongest bands as associated with the Swan bands under his experimental conditions Vibrational and fine structure analysis have now been made for the first time by

Dieke and Holtgreven, making this the third known system of the C_2 molecule

I had also recently made a vibrational analysis and a partial rotational analysis of this system, and my conclusions are in substantial agreement with these workers Although there is no state in common with the three known ($^3\Pi$) states of this molecule, there is ample evidence both from experimental conditions and fine structure analysis that the emitter is C_2 The characteristic 'staggering' of the structure lines due to σ type doubling, combined with alternate missing levels due to symmetry of the molecule is very evident, and the transition $^1\Pi \rightarrow {}^1\Pi$ is without doubt correct I have obtained plates of these bands in the first order of a 21 ft grating, and wave lengths of the heads are given in the accompanying table

Int	Wave Length (Heads)	ν (in Vacuo)	n	n''
5	3398 12	29419 6	3	1
5	3399 73	29405 7	2	0
7	3587 65	27865 5	3	2
7	3592 9	27824 8	2	1
8	3607 3	27713 7	1	0
5	3825 65	26132 0	1	1
10	3852 2	25951 9	0	0
1	4026 92	24825 9	3	4
3	4041 80	24734 5	2	3
6	4068 14	24574 3	1	2
9	4102 28	24369 8	0	1

In view of the higher resolving power used by Dieke and Holtgreven, it is unnecessary to enter into further detail of fine structure analysis It may be mentioned that the system appears well in a tube containing carbon electrodes and a little hydrogen together with 30-40 mm pressure of argon, and it has also been produced under high temperature conditions in the carbon arc in hydrogen

The data suggest that one (or more) of the initial vibrational levels is considerably perturbed, although it is not possible to specify precisely which, on the evidence at present available

In conclusion, it may be mentioned that it seems just possible that the strong (0, 1) sequence of this system may be contributory to the strong condensation in cometary spectra which centres about the wave length λ4050 (*vide Monthly Notices R A S*, vol 87, p 625, 1927)

R C JOHNSON

King's College,
Strand, W C 2

Crystalline 'Menformon'

FOUR years ago we gave the name 'menformon' to a female sexual hormone, which name, as distinct from other denominations, included in its definition a certain degree of purity of the product The biological and chemical properties of the substance were described in detail in various communications, to which one about its influence upon the plumage of the fowl was added recently [1]

About a year and a half ago we reached a degree of purity of 10,000,000 units per gram [2] by means of methods described by us [3]

In August last Doisy presented a communication to the Physiological Congress in Boston, according to which he has obtained crystals containing 8,000,000 units per gram Recently Butenandt described crystals again of the same degree of purity [4] Since this substance is not purer than that previously described by us, the giving of a special name to the crystalline hormone, 'progynon', seems unnecessary

Recently Dr J R Katz was kind enough to control our own preparations by means of X ray spectrography and found the structure undoubtedly to be crystalline Since last June we have obtained more of the substance partially purified by methods based on the idea that menformon is acidic in character With these larger quantities we have now succeeded in obtaining macro crystals in the form of colourless platelets, similar to those described by Doisy and by Butenandt and have been able to demonstrate that these crystals yield the same X ray spectrum as our earlier preparations of the same degree of purity They could be repeatedly recrystallised out of 70 per cent alcohol

While in our earlier experiments with less pure material in a vacuum of about 0 4 mm at a temperature of 200° C, we were unable to obtain trustworthy information concerning the possibility of distillation, we have now succeeded, like Butenandt, in subliming the material at a pressure of about 0 01 mm and 130° 150° C It is uncertain whether any further purification was obtained thereby The analyses so far carried out have yielded results similar to those of Butenandt, that is, 78 61 per cent carbon, 8 25 per cent hydrogen As we were able to show several years ago on less purified preparations, the crystals are free from nitrogen, sulphur, and phosphorus Experiments of Dr Katz on the spreading of the substance in a monomolecular layer on water yielded very delicate films The degree of spreading suggests that the substance under investigation contains not more than 25 carbon atoms

We may mention that during the purification of the raw material obtained from the urine of pregnant women, other crystals are also encountered, which through all the initial phases were associated with the active substance (melting point, 235° C, carbon, 78 1 per cent, hydrogen, 11 5 per cent) The X ray spectrum of these crystals is different from that of menformon This substance contains an OH group, because it may be acetylated and the acetyl derivative saponified Crystals of this description have been recently found by Marrian [5] and characterised as an alcohol of a formula $C_{19}-C_{20}$

Whether crystalline menformon of the above mentioned purity (8 10 million units per gram) really constitutes the pure hormone, is not quite certain, in which respect we agree with the cautious expression of Doisy [6] at the Congress In spite of careful recrystallisation, adsorption of the active substance on the crystals cannot be excluded The objective reason for our doubt is that we have succeeded in three cases up to the present in producing a substance of an activity of 14,000,000 units per gram

E LAQUEUR
E DINGEMANSE
S KOBER

Pharmaco therapeutic Laboratory of the University of Amsterdam and the Chemical Research Laboratory of the Organon Oss Co, Ltd

Dec 13, 1929

[1] *Proc Roy Acad Amsterdam*, 32 1929
[2] *Jour Pharmacol and Exp Therapeut*, 36, No 1, 1929
[3] *Lancet*, May 28, 1927
[4] *Naturwissenschaften* 17 p 879, 1929
[5] *Biochemical Jour*, 23, No 5, 1929
[6] *Nederl Vereen voor Bioch*, Nov, *Chem Weekbl*, 1929

Preparation of Œstrin

RECENT work from several laboratories strongly suggests that the œstrus producing hormone is a substance possessing weakly acidic properties If this is so, the methods in general use for the preparation and purification of the hormone, involving as they do numerous extractions with fat solvents from neutral or alkaline aqueous media, must result in great losses of

the active material This is borne out by the observation of Miss M Hill, privately communicated to me, that urine extracted as many as twelve times with ether may still contain large amounts of œstrin

If the urine is acidified before ether extraction, the yields of œstrin obtainable can be very greatly increased Three successive batches of fifty litres of urine treated in this manner yielded 2,069,000, 980 000, 1,000,000 mouse units, tested by the method recently described in the *Journal of Physiology* by Dr A S Parkes and myself The error in this method is little, if any, more than ± 10 per cent

Saponification and subsequent ether extraction of such crude ether soluble material, although effecting considerable purification, results in the loss of a great part of the total activity This loss can be minimised by saturating the saponified mixture with carbon dioxide before ether extraction (paper in press) The material obtained in this way can be further purified by extraction with ice cold acetone, extraction with ice cold 50 per cent alcohol, and finally extraction from ethereal solution with aqueous potash The active material may be extracted from this alkaline solution with ether after acidification The total loss of activity throughout the whole process of purification has been found to be approximately 40 per cent As the following table shows, practically the whole of this loss occurs in the initial saponification

	Wt (gm)	No M U	Wt 1 M U (mgm)	Yield M U per litre	Loss per cent
Total ether sol material from 50 l of urine	22	2 069 000	0 0106	41 380	
Unsap matter (after CO_2 treatment)	2 845	1 278 000	0 00223	25 560	38
Acetone sol	2 456	1 236 000	0 00199	24 720	40
50 per cent alcohol sol	0 742	1 236 000	0 000600	24 720	40
Alkali sol	0 364	1,208 000	0 000301	24 160	41 5

Similar results have been obtained with several other batches of urine

The most potent preparation of œstrin obtained by me by these methods had an activity of 8 million mouse units per gram This is of the same order of activity as the pure crystalline hormone described by Dr A Butenandt, of Göttingen, in a preliminary communication The latter, however, injects his material dissolved in oil in a single dose It is therefore somewhat difficult to compare the activity of the crystalline hormone with my obviously impure preparations

G F MARRIAN

Department of Physiology and Biochemistry,
University College, London,
Dec 23, 1929

The Product of the Radioactive Disintegration of Potassium

DIE obige Mitteilung der Herren Frost (NATURE, Jan 11), deren Korrekturbogen mir durch die Freundlichkeit des Editor der NATURE zur Einsichtnahme vorgelegt wurden, interessiert mich in ganz besonderem Masse, da ich derzeit mit dem Studium der gleichen Frage beschäftigt bin

Zu den Atomgewichtsbestimmungen der beiden Autoren möchte ich mir die Bemerkung erlauben, dass es mir zu gewagt erscheint aus den mitgeteilten Analysenresultaten weitgehende Schlüsse in der so wichtigen Frage nach der Existenz eines durch radioaktive Umwandlung des Kaliums entstandenen Calciumisotops zu ziehen

Um Atomgewichts Unterschiede der Isotope experimentell festzustellen, muss man zunächst über eine zuverlässige Bestimmungsmethode, die genügende Genauigkeit garantiert, verfügen Die von den beiden Autoren angewandte Methode, Umwandlung des $CaCl_2$ in $CaBr_2$, arbeitet zwar bei richtiger Ausführung, wie ich mich bei meiner Atomgewichtsbestimmung des Radiums überzeugen konnte, sehr gut und sicher, dennoch lieferte sie hier recht unsichere Werte Beträgt doch die maximale Differenz der drei mit gewöhnlichem Calcium ausgeführten Vergleichsbestimmungen 0,1 Einheiten des Atomgewichtes, ist also fast ebenso gross wie die festgestellte Differenz der Mittelwerte der Atomgewichte der beiden Calciumproben, die nur 0,12 Einheiten erreicht

Ferner muss es nach den bisherigen Mitteilungen fraglich erscheinen, ob die beiden Calciumproben in Bezug auf chemische Reinheit vergleichbar waren, da der spektroskopische Nachweis für die Abwesenheit der schweren Calciumhomologen, Strontium und Barium, fehlt Die von den Autoren angewandte Reinigungsmethode, wiederholte Fällung des Calciumsulfats und Oxalats, habe ich bei der Herstellung meiner atomgewichtsreinen Calciumpräparate, die auch gerade jetzt in meinem Laboratorium durchgeführt wird, niemals versucht, da ich sie von vornherein für nicht ausreichend erachten muss

Bevor man zu der grundlegenden Frage nach der Existenz des aus Kalium entstandenen Calcium Isotops Stellung nehmen kann, wird man die angekündigten weiteren Versuche der beiden Autoren abwarten müssen, die mit grösseren Materialmengen ausgeführt hoffentlich zuverlässigere Atomgewichtswerte liefern werden

O HÖNIGSCHMID

München

Preparations of Protozoa and Algæ

WISHING to get some permanent preparations of the Protozoa of West African forest pools, I have adopted a simple little technique which if not known is worth publication Two clean cover glasses are tied together back to back with thread, one end being left long They are suspended in the water with the lower edge just touching the bottom and sloping somewhat They are left for several days and then lifted out and immersed at once in alcoholic Bouin's fixative Afterwards I stain with Erlich's acid hæmatoxylin, 1 in 20 or 30 per cent alcohol, 3 hours, differentiate in 1 per cent acetic acid in 70 per cent alcohol, 1 3 hours, no counterstain being needed The cover slips may be kept tied together if desired up to the stage of dehydration Most, if not all, of the species of Protozoa and Algæ which may be seen in the fresh sample can be found excellently fixed and stained in the mounted specimen LL LLOYD

Azare, N P, Nigeria,
Nov 3

THE plan adopted by Dr Lloyd is excellent, providing always that it is not frustrated by (*a*) wind and rain, (*b*) fish, or (*c*) hungry marauders We adopted a similar plan in my tanks at Selsey when we were studying the bionomics of *Verneuilina polystropha* and *Massilina secans* We hung cover slips (*a*) vertically, and (*b*) horizontally close against the sides of the tanks, and they collected satisfactory gatherings of 'primordials' and very young tests I do not think it was an original operation, for I seem to remember having got the idea from something I had read EDWARD HERON ALLEN

The 'Wave Band' Theory of Wireless Transmission

By Sir AMBROSE FLEMING, F R S

IN scientific history we meet with many examples of scientific theories or explanations which have been widely adopted and employed, not because they can be proved to be true but because they provide a simple, easily grasped, plausible explanation of certain scientific phenomena The majority of persons are not able to see their way through complicated phenomena and so thankfully adopt any short cut to a supposed comprehension of them without objection

Ease of comprehension is not, however, a primary quality of Nature, and it does not follow that because we can imagine a mechanism capable of explaining some natural phenomenon it is therefore accomplished in that way There is a widely diffused belief in a certain theory of wireless telephonic transmission, and also of television, that for securing good effects it is necessary to restrict or include operations within a certain width of 'wave band' But although this view has been very much adopted there is good reason to think that it is merely a kind of mathematical fiction and does not correspond to any reality in Nature

Let us consider how it has arisen We send out from all wireless telephone transmitters an electro magnetic radiation of a certain definite and constant frequency expressed in kilocycles Thus 2LO London broadcasts on 842 kilocycles This means that it sends out 842,000 electric vibrations or waves per second Every broadcasting station has allotted to it a certain frequency of oscillation and it is not allowed to depart from it

It is like a lighthouse which sends out rays of light of one pure colour or an organ which emits a single pure musical note For most broadcasting stations this peculiar and individual frequency lies somewhere between a million and half a million per second, though for the long wave stations like Daventry it is so low as 193,000 or 193 kilocycles

When we speak or sing or cause music to affect the microphone at a broadcasting studio the result is to cause the emitted vibrations, which are called the *carrier waves*, to fluctuate in height or wave amplitude, but does not alter the number of waves sent out per second It is like altering the height or size of the waves on the surface of the sea without altering the distance from crest to crest which is called the wave length

Suppose the broadcasting station emits a carrier wave of frequency n and let $p=2\pi n$ Then we may express the amplitude a of this wave at any time t by the function $a=A\sin pt$ where A is the maximum amplitude If on this we impose a low frequency oscillation due to a musical note of frequency m and let $2\pi m=q$, then we can express the modulated vibration by the function

$$a=A\cos qt\sin pt$$

But by a well-known trigonometrical theorem this is equal to

$$\frac{A}{2}\left\{\sin(p+q)t+\sin(p-q)t\right\},$$

and thence may be supposed to be equivalent to the simultaneous emission of two carrier waves of frequency $n+m$ and $n-m$

If the imposed note or acoustic vibration is very complex in form, then in virtue of Fourier's theorem it may be resolved into the sum of a number of simple harmonic terms of form $\cos qt$, and each of these may be considered to be equivalent to a pair of co-existent carrier waves Hence the complex modulation of a single frequency carrier wave might be imitated by the emission of a whole spectrum or multitude of simultaneous carrier waves of frequencies ranging between the limits $n+N$ and $n-N$, where n is the fundamental carrier frequency and N is the maximum acoustic frequency occurring and $2N$ is the width of the wave band This, however, is a purely mathematical analysis, and this band of multiple frequencies does not exist, but only a carrier wave of one single frequency which is modulated in amplitude regularly or irregularly

If the sounds made to the microphone at the broadcasting station are very complex, such as those due to instrumental music or speech, then in virtue of this mathematical theorem the very irregular fluctuations in amplitude of the single carrier wave can be imitated if we suppose the station to send out simultaneously a vast number of carrier waves of various frequencies lying between certain limits called the "width of the wave band"

This, however, is merely a mathematical artifice similar to that employed when we resolve a single force or velocity in imagination into two or more component forces Thus, if we consider a ball rolling down an inclined plane and desire to know how far it will roll in one second, we can resolve the single vertical gravitational force on the ball into two components, one along the plane and one perpendicular to it But this is merely an ideal division for convenience of solution of the problem, the actual force is one single force acting vertically downwards Similar reasoning is true with regard to wireless telephony What happens, as a matter of fact, is that the carrier wave of one single constant frequency suffers a variation in amplitude according to a certain regular or irregular law There are no multiple wave lengths or wave bands at all

The receiver absorbs this radiation of fluctuating amplitude and causes the direct current through the loud speaker to vary in accordance with the fluctuations of amplitude of the carrier wave, the carrier wave vibrations being rectified by the detector valve

The same thing takes place in the case of wireless transmission in television The scanning spot passes over the object and the reflected light falls on the photoelectric cells and creates in them a direct current which varies exactly in proportion to the intensity of the reflected light This photoelectric current is employed to modulate the amplitude of a carrier wave, and the neon lamp at the receiving end translates back these variations of carrier wave

amplitude into variations in the cathode light of the neon tube

There is neither in wireless telephony nor in television any question of various bands of wave length There is nothing but a carrier wave of one single frequency which experiences change of amplitude The whole question at issue then is, What range in amplitude is admissible ?

In the case of television it is usual for critics of present achievements to say that good or satis factory television cannot be achieved within the limits of the nine kilocycle band allowed But there is in reality no wave band involved at all It is merely a question of what change in amplitude in a given carrier wave can be permitted without creating a nuisance

It is something like the question How loud can you whisper to your next neighbour at a concert or theatre without being considered to be a nuisance ? People do whisper in this way, and provided not too loudly, it is passed over But if anyone is so ill mannered as to speak too loudly he is quickly called to order, or turned out

It is, however, not an easy thing to define a limit to wave amplitudes They are measured in micro volts per metre and are difficult to measure But a wave length is easy to define in kilocycles or in metres, and hence the method has been adopted of limiting emission to an imaginary band of wave lengths which, however, do not exist

The definition is imperfect or elusive It is something like the old fashioned definition of metaphysics as " a blind man in a dark room groping for a black cat which isn't there " Similarly, the supposed wave band is not there All that is there is a change, gradual or sudden, in the amplitude of the carrier wave It is clear, then, that sooner or later we shall have to modify our code of wireless laws

We have no reason for limiting the output of our broadcasting stations to some imaginary wave band of a certain width, say nine kilocycles or whatever may be the limiting width, but we have reason for limiting the range of amplitude of the carrier waves sent out

Some easily applied method will have to be found of defining and measuring the maximum permissible amplitude of the carrier waves as affected by the microphone or other variational appliance It may perhaps be thought that an unnecessary fuss is here being made on what may be regarded as simply a way of explaining things, but experience in other arts shows how invention may be greatly retarded by unessential official restrictions Consider, for example, the manner in which mechanical traction was retarded in Great Britain for years by ridiculous regulations limiting the speed of such vehicles on highway roads The only restrictions that should be imposed are those absolutely necessary in the interests of public safety or convenience, and all else tend to throttle and retard invention and progress

The Growth of Education in India [1]

IN 1928 the Indian Statutory Commission appointed an Auxiliary Committee to inquire into the growth of education The Committee's views are now made public as an Interim Report of the Simon Commission The Committee consisted of six members, of whom three are Indians The minute of their appointment indicated that the Commission is primarily concerned with education in British India as bearing upon political and constitutional conditions and potentialities of progress The Committee realised the limitations thus laid upon it, but had difficulty in confining itself to a consideration of the subject in this aspect only So far, however, as this aspect is concerned, the result of the Committee's investigations, regarded as an index of administrative progress under the reformed constitution, is sufficiently disturbing

" Throughout the whole educational system ", runs the Committee's Report, " there is waste and ineffectiveness In the primary system, which from our point of view should be designed to produce literacy and the capacity to exercise an intelligent vote, the waste is appalling So far as we can judge, the vast increase in numbers in primary schools produces no commensurate increase in literacy, for only a small proportion of those who are at the primary stage reach Class IV, in which the attainment of literacy may be expected

The wastage in the case of girls is even more serious than in the case of boys "

[1] Indian Statutory Commission Interim Report of the Indian Statutory Commission (Review of Growth of Education in British India by the Auxiliary Committee appointed by the Commission), September 1929 (Cmd 3407) Pp xxxiii+401 (London H M Stationery Office, 1929) 4s net

Out of the meagre percentage (4 26) of the total population who are receiving instruction in recognised institutions, how many will retain any traces of literacy in after life ? Nor is this all The average pay of a primary school teacher in Bengal is about thirteen shillings a month, in only two provinces are more than half of the primary teachers trained, and, despite the increased number of institutions, the inspecting staff has in recent years been reduced In the light of these facts, the Committee's approval of a policy of consolidation and improvement rather than of diffusion is less surprising than the declaration that the adoption of compulsion is important and urgent as an effective means of checking the wastefulness of the present system

The Committee views the condition of secondary education with greater complacency—a complacency which is not shared by one of its members, Sir Amherst Selby Bigge The average annual cost of a pupil in a secondary school in Bengal is forty five shillings In the same province only twenty per cent of the secondary teachers are trained The curriculum is narrow and, together with the teaching, is dominated by the matriculation

examination From Bombay (where such schools are maintained at a far higher cost than in Bengal) it is reported that "with every increase in the numbers of those taking secondary education there is a fall in the standard of efficiency, owing chiefly to the fact that lower and lower strata are being tapped, and the majority of those who pass the school-leaving examination are altogether unfit for higher studies" The Committee endorses this last criticism when it comments adversely on the inadequate qualifications of high school students who enter upon university courses, "a low standard of university work means a low standard of school work" It admits that there are grave defects in the organisation of secondary education It considers that there has been an advance in some respects, but the reader is tempted to ask from what level, and by what gauge, the progress is to be measured

On the subject of higher work in the universities, the Report says that lists of original study recently published by university teachers and students and by institutions like the Indian Institute of Science at Bangalore, the Jagadis Bose Institute, and the Government Research Departments, show that a considerable advance has been made The research carried out, both in arts and in science, at the University of Dacca is specially mentioned The growth of honours schools and of post graduate courses in the universities generally is regarded as a welcome sign But it is inevitable that an inquiry into education as a factor in the creation of good citizens should deal mainly with the qualifications of the average product of the universities "There are unmistakable indications", says the Report, "that the standards in some of the universities are not satisfactory" Indeed, signs of deterioration are observed "There is no evidence of any improvement in entrance standards between 1918–19 and 1924–25, yet the number of passes at the B A and B Sc degree examinations rose in those years from 50 per cent to over 70 per cent" Some of the witnesses asserted that "the student of the present day is not equal, either in the width of his information or in the range of his interests, to the student of an older generation" It is interesting to find this view borne out by the "Ninth Quinquennial Review of Indian Education", the appearance of which synchronised with that of the Committee's Report This review, commenting on the subordination of teaching to examination, says that "it is still rare to find in any candidate, however proficient he may be in the subjects which he offers for examination, any evidence of that background of wider interest which can only be acquired by general reading and observation outside his prescribed course of study" In confirmation of this, answers are quoted which were given by fifty-five graduates of one of the universities to questions asked in a simple paper on general knowledge Among the astonishing results, fifteen of these graduates recommended charms and incantations as a cure for snake bite

Defective teaching in secondary schools, easy admission to colleges and the tyranny of examinations are obvious causes of this state of affairs The remedy is less obvious The Commission (known as the Sadler Commission) which was appointed in 1917 to inquire into the affairs of the University of Calcutta, made two admirable suggestions One was the relegation of the first two years of college instruction (called the Intermediate stage) to separate institutions organised less on collegiate than on school lines The other was the creation of a new type of unitary teaching and residential university In Calcutta itself these proposals fell on deaf ears Elsewhere (notably in the United Provinces) attempts have been made to give effect to them in a greater or less degree The "Quinquennial Review" says that but little has been accomplished in respect of the former of these recommendations—the establishment of Intermediate Colleges—and that the experiments are not on the whole very hopeful The Committee accounts for this failure by the fact that in many cases these institutions have not been established under the conditions recommended by the Sadler Commission The second suggestion is in part responsible for the large increase in the number of universities of British India—from five in 1915 to fifteen to day But of these fifteen only five are unitary, and the "Quinquennial Review" points out that the two universities created during the last quinquennium have reverted to the affiliating type and that the University of Rangoon also has assumed affiliating functions

The Committee justly remarks that the affiliating university is likely to remain for many years to come, and it may be noted as a sign of grace that it now generally participates in the work of higher teaching But it might have been hoped that the establishment of unitary universities, with their greater concentration of teaching effort and of social amenities, would gradually reduce the number of scattered colleges (often ill staffed and ill equipped) which prepare the majority of students for the examinations of an affiliating centre Instead of this, there has been a new growth of these affiliating and examining centres, with the danger, as the Committee more than hints, of unwholesome competition, and the number of affiliated arts colleges has actually risen from 152 in 1922 to 232 in 1927 The task of university reform in India is Sisyphean Well may the Committee ask whether "the time has not come when all efforts should be concentrated on improving university work, on confining the university to its proper function of giving good advanced education to students who are fit to receive it, and, in fact, to making the university a more fruitful and less disappointing agency in the life of the community"

Other points in this Report are no less disquieting The Central Advisory Committee and the Bureau of Education, which constituted practically the last links between the Government of India and educational problems, have been abolished The Committee regrets their disappearance, for, though the reforms have favoured expansion,

"much of that expansion has been on ill considered lines and neglectful of the proposals made by the Government of India previously to the reforms" Education, as a transferred subject, is now in the hands of ministers in the provinces A tribute is paid to the zeal and ability which these ministers bring to bear upon their task But the position of a minister is unstable He cannot easily escape from adverse influences It was represented to the Committee that in some provinces he had exercised pressure on the Director of Public Instruction in the matter of appointments and promotions on political and irrelevant personal grounds Moreover, he has to work through various agencies, such as local bodies, which, the report notes as a distressing feature, "have in many instances gravely abused their powers for political and other purposes" He is likewise largely dependent on the services which deal directly with education The Indian Educational Service, 'with its fine traditions of integrity and devotion to duty", is moribund The Committee declares that its progressive extinction, accompanied by the failure to reconstitute the provincial Services, "has been disastrous to the organisation of Indian education" "The number of fully qualified men and women, competent to hold the higher posts in the Department, has become totally inadequate in every province"

The attitude of the Committee has clearly been sympathetic But the studied restraint of the report serves to emphasise some of the conclusions into which facts have forced its members If literacy is a desirable qualification in the voter, an expansion of mass education which is (in the words of the report) "so largely ineffective as scarcely to influence the advance of literacy at all in the sense of increasing the proportion of literates to the population" cannot result in the formation of a competent electorate Nor, however brilliant may be the exceptional scholar, does a top heavy superstructure of higher education, coupled with relaxation of the standards of admission and too often with unemployment after completion of the course, promise well for the production of sound representatives and officials Above all, this narrative of educational work during the past few years indicates a fatal tendency to loosen the framework on which the whole fabric depends for support H SHARP

Bochart de Saron, 1730–1794

WHEN Herschel, in April 1781, announced the appearance of a new body in the heavens, nowhere did the news create greater interest than in France, where Lalande, Mechain, Lemonnier, Laplace, and Bochart de Saron attempted to discover the orbit in which the body moved Based on the supposition that it was a comet, the investigations all failed until Bochart de Saron, on May 8, 1781, announced that the so called comet was in reality much farther from the sun than had been thought This was the first glimmering of light on the perplexing subject which eventually led to the discovery that Herschel's 'comet' was a new planet, to which he assigned the name Georgium Sidus, but was afterwards designated Uranus

Jean Baptiste Gaspard Bochart de Saron, born on Jan 16, 1730, two hundred years ago, was as distinguished in law as in science He served as president of the Parliament of Paris, and at his seat in Champagne had an observatory partly furnished by Ramsden It is said, also, that a duplicate of Ramsden's dividing machine was introduced into France by him, concealed in the pedestal of a table Especially interested in comets, he became a member of the Paris Academy of Sciences, and it was he who paid for the printing, in 1784, of Laplace's "Théorie du mouvement et de la figure des planètes" But, ten years later, neither his eminence as an astronomer or as a lawyer could save him from the fury of the Terror, and he perished beneath the guillotine

The king had fallen in January 1793, Marie Antoinette in October, the academies had all been suppressed, the scaffold had alike claimed Bailly, Madame Roland, and Danton, and executions could be counted by the hundred On April 13, 1794, nineteen were condemned, on April 18 a further seventeen, mostly of the nobility, and on April 20, Bochart de Saron and twenty four of his fellow ex presidents and counsellors of the Parliaments of Paris and Toulouse suffered It was to see this 'batch' tried that the Auvergnat carpenter, Trinchard, wrote the invitation, "If you are not alone and the journeyman is working, you can, my dear wife, come to the court to see twenty four gentlemen, all of them former presidents or counsellors passed in judgment I advise you to get something to eat before coming, as we shall not have finished before three o'clock"

There was never any doubt of the finding of the court, and while it was still sitting Fouquier was ordering the tumbrils and the escort Presiding over the court which condemned Bochart de Saron was the notorious Coffinhal, who a few days later, when trying the Farmers General, immortalised himself by replying to the great Lavoisier, who had asked for a delay in order to allow him to conclude an experiment, The Republic requirés neither savants nor chemists, the course of justice cannot be suspended" For three months longer the guillotine continued to rob France of some of her greatest minds With the fall of Robespierre on July 28, the nation breathed again, and the year which saw the death of Condorcet, Bochart de Saron, and Lavoisier, also saw the foundation of the great institutions, the École Normale, the École Polytechnique, and the Conservatoire des Arts et Métiers, while the year 1795 saw the inauguration of the famous Institut de France

Obituary.

Dr Samuel Rideal

Samuel Rideal was born in London in 1863 His father was John Rideal He obtained a scholarship at Dulwich College, 1875–1878 For a short time he studied at the Royal School of Mines, but afterwards went to University College, London, where, in 1883, he became assistant to Dr A W Williamson He retained this post for a year or two under Sir William Ramsay, but in 1889 became lecturer on chemistry at St George's Hospital Medical School He was a brilliant student, and in 1884 took the degree of bachelor of science at the University of London, with first class honours, and a University scholarship in chemistry Two years later he received the degree of doctor of science, his subject being inorganic chemistry In 1888 he was elected a fellow of University College, London Already in 1878 he had become a fellow of the Institute of Chemistry, upon the council of which he served during the years 1899–1902

About the year 1890, Rideal became public analyst for Chelsea, and was also, for a short time, public analyst for Lewisham He set up a consulting practice at 28 Victoria Street, S W, and retained an active interest in the work for thirty five years He married Lilla, daughter of the late Samuel Keightley, of Bangor, Co Down, and sister of Sir Samuel Keightley, barrister and novelist Dr Rideal's son, Eric K Rideal, is Humphrey Owen Jones lecturer in physical chemistry at Cambridge, and fellow of Trinity Hall He has taken up his father's work in conjunction with Mr A Sciver

While at University College, Rideal published several researches in pure chemistry, such as the action of ammonia on chromyl dichloride, on tungsten compounds, and on the halogen compounds of boron A new volumetric method for the estimation of nitrous acid depending upon the conversion of an acid solution of aniline into diazo benzene was published by Arthur G Green and S Rideal in 1884

Dr Rideal became a recognised authority on the disposal and disinfection of sewage, the purification of water and sanitation generally His book on "Sewage and the Bacterial Purification of Sewage" went through three editions, while that on "Water and its Purification" published in 1897, had a new edition in 1901 With his son, Dr Eric Rideal, he published "Public Water Supplies" in 1914 The Rideal Walker method for determining the antiseptic value of disinfectants is widely used Rideal also studied carefully the use of electrolytic chlorine and of ozone in the purification of sewage He was well known as an expert witness in the courts and gave evidence in a large number of Parliamentary inquiries

Rideal's indefatigable energy in overcoming difficulties and his frank manner gained the confidence of those who had to work with him To the great sorrow of his many friends, his health gave way, so that he had to take a prolonged rest He died at Hartley, in Southern Rhodesia, on Nov 13 last, at the age of sixty-six years

Dr A N A Nalepa

Dr August Nemesius Alfred Nalepa, the well-known acarologist, of Baden, near Vienna, died after a short illness on Dec 11 last Nalepa was born at Versecy, in Hungary, on Dec 15, 1856 He was educated at the University of Vienna and later joined the staff and became assistant zoologist at the University

Nalepa commenced to study the gall mites (Eriophyidæ) in 1880, and seven years later he published his fundamental and unique work entitled "The Anatomy of the Phytoptera" The gall mites are considered to be the most primitive animals of the order Acarina, they are all microscopic in size and are entirely herbivorous in their habits Nalepa studied them mainly from a systematic point of view, and as a result of his researches more than four hundred new species have been described He was a prolific writer, and his publications in relation to gall mites number about one hundred Of these, his works entitled 'Eriophyidæ", in "Das Tierreich" (Berlin, 1898), and "Eriophyiden, Gallenmilben", *Zoologica*, 61 (Stuttgart, 1910), are widely known, and are still recognised as the standard works on the subject

For prominent services rendered to education and scientific research Nalepa was honoured with the Emperor Franz Joseph Order and also the title of State Councillor He was very generous, and delighted in assisting and advising other students engaged in research on the Eriophyidæ, and his immense knowledge of the group, together with sound criticism, always proved of great value to those who had the pleasure of corresponding with him

Nalepa took an active interest in gall mites until the last, and was about to publish a new paper in collaboration with the present writer on 'The Habits of Gall Mites" at the time of his death He possessed a magnificent collection of gall mites contained in small glass vials This collection is unique, and will in all probability be presented to the trustees of the Vienna Museum of Zoology

A M Massee

Dr Wilhelm Maybach

The death of Dr Wilhelm Maybach at Stuttgart on Dec 29 removes the last of the four great German pioneers whose names will always be associated with the perfection of the internal combustion engine and its application to road transport Nicolas Otto, who died on Jan 26, 1891, Gottlieb Daimler, who died on Mar 6, 1900, Karl Benz, who passed away in April last, and Maybach, all made important contributions to this subject, and to their names might be added that of Eugen Langen, 1833-1895 Just as Maybach for many years was connected with Daimler, so seventy years ago Otto had found in Langen a most able collaborator and partner

Otto began his long struggle with gas engine difficulties in 1854, with Langen in 1867 achieved partial success, and then ten years later, on Aug 4, 1877, took out his great patent for the four stroke

engine so widely used to-day Moreover, in 1872, the partners founded the Gasmotorenfabrik Deutz Aktiengesellschaft, near Cologne, in which both Daimler and Maybach worked

The partnership of Daimler and Maybach dates from the 'eighties, and Daimler in 1884 invented the light high speed spirit engine which the following year was applied to road carrriages by Karl Benz The first motor car imported into England, as also the first imported into the United States, was a Benz In the subsequent improvements of the 'nineties, Daimler and Maybach both had a large share, and the Mercedes car exhibited by Maybach at the Paris Exhibition in 1900 was named after Daimler's daughter

Daimler dying in 1900, Maybach took over the direction of the Daimler works, retiring in 1907 His son's work for Count Zeppelin, however, led to his taking up active work again, and for many years he has been engaged with the management of the Maybach Motorenbau G m b H at Friedrichshaven, the first subsidiary company of the Zeppelin works A fine example of a Maybach airship engine is to be seen in the Science Museum at South Kensington, and it may be recalled that the 530 h p engines with which the airship *Graf Zeppelin* is equipped were supplied by the firm Maybach was born at Heilbron on Feb 9, 1846, and was thus in his eighty fourth year

WE regret to announce the following deaths

Major P G Craigie, C B, formerly assistant secretary to the Board of Agriculture and Fisheries, who was president of the Royal Statistical Society in 1902 and president of Section F (Economic Science and Statistics) at the Bradford meeting (1900) of the British Association and of the Sub Section of Agriculture at the Winnipeg meeting (1909), on Jan 10, aged eighty six years

Dr S Z de Ferranti, F R S, president in 1910 and 1911 of the Institution of Electrical Engineers, on Jan 13, aged sixty five years

Prof Henry D Hooker, associate professor of horticulture at the University of Missouri, known for his work on the chemical composition of fruit plants and on plant reactions, on Oct 26, aged thirty seven years

Mr Maximilian Mannaberg, well known in the iron and steel industry, who was one of the founders of the British Engineering Standards Association and also of the Institute of Fuel, on Dec 18, aged seventy-two years

Sir Thomas Matthews, formerly engineer in chief to Trinity House, who was well known in connexion with the design and equipment of lighthouses, on Jan 13, aged eighty years

Mr Henry Nehrling, collaborator in the Bureau of Plant Industry of the U S Department of Agriculture, known for his work in horticulture and ornithology, on Nov 22, aged seventy six years

Mr E A Pinchin, public analyst to City of London and the Boroughs of Camberwell and Islington, on Dec 23, aged fifty five years

News and Views

REPORTS appeared in the daily Press last week announcing the recent death of Prof A A Michelson, the distinguished physicist of the University of Chicago We are happy to be able to state, on the authority of a cablegram from Science Service, of Washington, D C, in reply to an inquiry by us, that these reports are incorrect and that Prof Michelson is on his way to enjoy a holiday in Bermuda after his recent illness A detailed account of Prof Michelson's work was given by Sir Oliver Lodge in NATURE of Jan 2, 1926, when Prof Michelson was added to our series of Scientific Worthies It is stated in *Science* of Dec 27, 1929, that he has resigned his position in the University of Chicago as head of the department of physics, and that after his visit to Bermuda, he intends to go to Pasadena, California, to carry out further work on the velocity of light We are sure that scientific workers throughout the world will join with us in congratulating Prof Michelson that he has survived his obituary notice, and also in wishing him many years of health and strength to add to those fundamental measurements for which the world is already indebted to him

SUGGESTIONS have recently appeared in the Press to the effect that the Middlesex County Council is contemplating acquiring Syon Park, which is situated on the banks of the Thames immediately opposite the Royal Botanic Gardens, Kew, for the development of a sewage disposal scheme Local opposition was quickly aroused, while on Jan 9, at a well attended meeting, the Linnean Society of London passed the resolution ' That the Society views with the utmost concern and regret the reported proposal in regard to the grounds of Syon House" The meeting requested the president and secretaries to make public this resolution and to express at greater length the sentiments evidenced in the decision The Society deplores the proposal to acquire Syon Park for sewage disposal and earnestly hopes that nothing will be done to mar the singular beauty of the Syon reach of the River Thames It considers that Syon Park should be safeguarded from any form of spoliation or 'improvement' such as a riverside embankment which would be inimical to the wild river life for which this is one of the few remaining localities near London, and in which lovers of Nature find their interest and their duty

IT is now just over a century since Lamarck died (see NATURE, Dec 14, 1929, p 922), and his remains lie in an anonymous grave in Montparnasse cemetery, Paris The only memorial which France had of him was the house where he was born, the home of his ancestors, at Bazentin, a small village of the Somme, not far from Albert For four years, Bazentin was in the zone of the Somme fighting, and the locality is well known to many who served in the British Army on the Western Front Of Lamarck's house, only a few scattered bricks and blackened stones are now left The Société Linnéenne du Nord de la France has therefore decided to raise a fund with the view of erecting, on the site of the old house, a memorial worthy of Darwin's precursor This memorial will

stand in the middle of a garden, in which the plants grown will be the botanical species especially studied by Lamarck or named after him by other botanists Lamarck belongs not to Picardy or to France but to the whole world, his work on classification made possible noteworthy advances in biology, and his views on evolution are still the subject of debate A memorial to him is an object in which scientific workers of all nationalities may fittingly co operate Remittances should be directed to Banque de France, succursale d'Amiens (Somme) au Compte Société Linnéenne souscription Lamarck—No 2433 All correspondence should be sent by May 15 next to M le Secrétaire Général du Comité Lamarck, 81 Rue Lemerchier a Amiens (Somme)

THE problems which face the introducer of foreign species of animals to a new country are as difficult to solve in advance as they are many The subject came before the Linnean Society recently in connexion with the proposed introduction of black buck into Ceylon, and a resolution was passed and communicated to the Colonial Office deprecating the introduction and naturalisation of wild animals or plants into new countries except after thorough study of the local conditions and possible results But even when a creature has made good in the land of its naturalisation there may still be acute differences of opinion about the economic success of the venture The introduction of the musk rat (*Fiber zibethicus*) to Europe for the sake of its fur is a case in point Dr Hjalmar Broch showed (in *Naturen*, No 1, 1929) that this species, introduced into Bohemia, has over run much of southern Europe, and has become a pest against which strong measures have been taken (see NATURE, May 18, 1929, p 775)

DR BROCH's article, and particularly his statement that the experience of southern Europe should prevent any relaxation of the law prohibiting the importation of live musk rats to Norway, has been met by a spirited protest from Ludv Munsterhjelm (*Naturen*, p 120, 1929) This author cites the experience of Finland, where the musk-rat was liberated on several small estates in two districts some years ago From neither area have reports of damage to crops been received, nor has there been any undue tendency of the creature to spread beyond its proper domain The difference appears to be traceable to topographical and climatic conditions In the warmer plains of southern Europe all the conditions favoured abundant food supply and rapid breeding, whereas the mountains of Finland, with their unsettled weather, imposed a natural check upon multiplication and dispersal Munsterhjelm considers that there is no probability of the spread of the musk rat overland to Norway, and holds that in Norway itself the musk rat might well be bred profitably and without incurring risk of damage to crops or property

ATTENTION is being directed to the possibilities of the transference of diseases, human, animal, and plant, by air routes Owing to the rapidity of air transit, an individual in the incubation stage of cholera might board an air liner in China, land at Los Angeles within two or three days, and develop the disease a day or two later, with the risk of spreading cholera far and wide Another serious event would be the introduction of yellow fever into Asia by this means When travel is slower, as by steamship, there is usually time for the disease to develop en route before the next large community is reached Aerial boarding stations for quarantine officers have already been envisaged by public health authorities, and we learn from a radio talk issued by Science Service, of Washington, D C, that the U S Public Health Service has detailed quarantine officers expressly for the inspection of air craft at the landing fields before the passengers or crew disembark

ON Jan 14, 1830, appeared the first number of *Das chemische Zentralblatt*, which at that time was also designated *Das pharmaceutische Centralblatt* The centenary of this well known reference work was marked by the delivery of an address to the German Chemical Society by Dr Maximilian Pflücke on Nov 11, 1929 The address, which is published at length in the December issue of the *Berichte der Deutschen Chemischen Gesellschaft*, deals with the early history and subsequent development of the journal The original purpose of the undertaking was to provide pharmacists with an accurate survey of the new and important facts of interest to them which were being discovered not only in Germany but also in France, England, Holland, and Italy At first the issue was fortnightly, but ever since September of the first year of publication it has appeared weekly in spite of the enormous difficulties arising from the War The extraordinary growth of the work can be gauged from the fact that the number of abstracts in the first volume amounts to about one per cent of those now appearing annually, and many of the original sources are now obsolete The first editor, Herr Gustav Theodor Fechner, was able to undertake the whole survey himself One of his earliest problems was apparently connected with nomenclature, and he decided to be guided by the system of Berzelius After several changes, the editorship passed into the hands of Prof Rudolf Arendt in 1862, who guided its destiny for about forty years So successful was the work under his direction that in 1895 the German Chemical Society decided to take over the management, and shortly after Arendt's death in 1902 the headquarters were moved from Leipzig to the newly established Hofmann Haus in Berlin

TWO replicas of 'Les Bisons d'Argile' of the Tuc d'Auduobert Cave of the Ariège district are on their way to Canada one, ordered by Dr Ami, the director of the Canadian School of Prehistory in France, for Ottawa, the other, ordered by Prof W A Parks, of the Geological Department of the University of Toronto, Canada It is well that Canada should possess replicas of that wonderful piece of Magdalenian art, modelled some twenty thousand years ago when the bison dwelt in south western France in large numbers The bison to day is a typical Canadian animal, and it is not yet extinct, nor does the Canadian Government, if we understand aright, mean the race to pass out The *bisons* represented on the clay mass

—beautifully carved and sculptured—measure as a piece of art more than two metres in length, and form a most impressive spectacle from every point of view The magic in art is well exemplified there, and it is to be regretted that, so far, no specimen of the few replicas being prepared for university or prehistoric museums is to be seen in Great Britain These replicas are being prepared under the supervision of Count Begouën of the University of Toulouse, France

MISS SYLVIA SEELEY, of the Canadian School of Pre history in France, whose able presentation of Count Begouen's views on "The Magic Origin of Prehistoric Art" appeared in the March number of *Antiquity*, has recently been co operating with him in the University of Toulouse, in the preparation of a comprehensive statement of the subject So much new material has of late been, and is every week being, discovered by different members of the Begouen family, and by others working in the Ariège (Pyrenees) caves, that unless someone brings together every once in a while the re sults obtained in synthetic form and interprets the facts obtained in the light of prehistoric science and art, much time is lost and progress retarded The work undertaken by Miss Seeley, in collaboration with Count Begouèn, promises to open new vistas in the hidden treasures of those Pyrenean caves The discovery of the grasshopper, of the owls, of the rare engravings and paintings in the Grotte des Trois Frères, near Pryòl, Ariège, are absorbing their attention, and will mark an interesting phase of prehistoric art in the light of what those discoveries themselves teach

THE University of St Andrews has planned an ambitious and admirable series of lectures under the adult education scheme for Fife and Stirlingshire The title of the course and of the 60 page 'Synopsis' published by the University Press of St Andrews, "Man and his World in the Light of Emergent Evolution," suggests the general scope of the series, but it gives no idea of the care with which the lectures have been devised and arranged to give a connected story, from the evolution of matter and the universe by way of the evolution of living things to the emer gence of mind and its products It endeavours to place in their due relationships and to give unity to the discoveries of the sciences and the developments of civilisation Each of the twenty lectures has been written by an expert, generally the professor of the particular subject at the University, and in spite of the contraction of an hour's lecture into an average of two pages, the synopsis still carries the theme through with a swing It is a pity that so excellent a course should be introduced by a preface the intellectual sufficiency of which would damp the ardour of many a modest inquirer after knowledge

A REGULAR public service of picture telegraphy be tween London and Berlin is now in operation The Siemens Carolus system has been adopted and some of the pictures we have seen transmitted in this way are extremely good, with the exception of a slight tendency to exaggerate the blacks and the whites, the results are admirable It is expected that the newspapers will be the largest users of this service It will probably be used whenever it is necessary to send architects' plans and engineering drawings as quickly as possible Cheques and legal documents with the signatures in facsimile can also be sent use fully in this way Scotland Yard will doubtless make use of it to send the photographs of 'wanted' persons to seaports so as to prevent them leaving the country Similar services already exist between Berlin and Copenhagen, Berlin and Vienna, and Berlin and Stockholm

THIS year the picture telegraphy service will be extended to Munich and other German towns and to Holland and Belgium The London to Berlin circuit is about a thousand miles long and consists of cable throughout During the experimental stage, con siderable trouble was experienced owing to inductive interference with other circuits, but this source of trouble has now been eliminated The charge for sending picture telegrams from Great Britain is at the rate of $2\frac{1}{2}d$ a square centimetre, which is equivalent to about a pound for fifteen square inches There is a minimum charge of one pound Some success has been achieved in radio picture telegraphy between Berlin and Buenos Ayres From the commercial point of view the services do not seem to be attractive, but they may nevertheless serve a useful function

Now that it is possible to communicate with nearly ninety per cent of the world's telephone stations from any one of the 1,900,000 subscribers' stations of the British Post Office, a vast amount of work has to be done in maintenance In addition, as last year there were 125,000 new subscribers, thousands of miles of new cable had to be laid In the *Electrician* for Dec 27, P E Erikson says that the rate of progress is such that one new public exchange and 1000 new telephones (including replacements) are installed for each working day of the year Fifteen new large automatic stations were completed in London last year Of the twelve next largest towns in Great Britain, five are completely converted and four are well under way An important development put into operation last year is the installation of rural auto matic exchanges Ninety exchanges have been installed providing day and night service to outlying subscribers, who would otherwise have only a limited day working When a minimum of eight subscribers is forthcoming, rural automatic exchanges are being installed Many new districts have been added in countries in which communication was already estab lished In Italy, for example, a recent installation of a carrier system provides three additional channels over an existing wire line and has greatly increased the service The new hand set which is being introduced as an alternative to the familiar pedestal pattern telephone is excellently designed Hand set telephones have been in use on the Continent for many years, but the speech transmission characteristics of these have been markedly inferior to the pedestal sets, the new hand sets have, on the other hand, superior char acteristics Successful ship to shore conversations be tween New York and the *Berengaria* up to distances of about a thousand miles were carried out during last year

A CONFERENCE arranged by the National Institute of Agricultural Botany, with the assistance of the Royal Agricultural Society of England and the National Farmers' Union, was held on Jan 8 to discuss the question of cereal synonyms and means of eliminating them Representatives of the Agricultural Seed Trade Association and of the National Association of Corn and Agricultural Merchants also took part in the conference It was agreed that it is undesirable in the interests alike of agriculturists, plant breeders, and the seed trade that stocks of wheat, barley, and oats sold for seed which are of identical origin and character should be sold under different names The name under which such stocks are sold should be that given by the original producer, with the addition of words indicating that further selection has taken place where this has been done It was also resolved that a standing committee of reference, consisting of one representative of each of the five associations and of the Cambridge University Plant Breeding Institute should be formed to investigate and report on infringements of the recommendations of the conference The secretary of the National Institute of Agricultural Botany is to act as convener of the committee of reference

THE Geological Society of London has this year made the following awards of medals and funds The Wollaston Medal to Prof A C Seward, master of Downing College and professor of botany in the University of Cambridge, in recognition of the value of his researches in stratigraphy and palæobotany, the Murchison Medal to Mr A L Hall, of the Geological Survey of South Africa, for his researches on the stratigraphy and economic geology of South Africa, a Lyell Medal to Mr F Chapman, palæontologist to the Federal Government of Australia, in recognition of his work in palæontology (especially on the Foraminifera), and of his researches on the tertiary rocks of Australia, a second Lyell Medal to Mr H B Maufe, Director of the Geological Survey of Southern Rhodesia, for his work on the geology and mineral resources of that Colony, the Wollaston Donation Fund to Mr E G Radley, of H M Geological Survey, in consideration of his work on the chemical analysis of rocks and minerals, the Murchison Geological Fund to Mr John Smith of Dalry, in recognition of his contributions to the geology and palæontology of western Scotland, the Lyell Geological Fund to Miss H M Muir Wood, in recognition of her work on the palæontology of the Brachiopoda

THE Harrison Memorial Prize Selection Committee, consisting of the presidents of the Chemical Society, Institute of Chemistry of Great Britain and Ireland, Society of Chemical Industry, and Pharmaceutical Society, has awarded the Harrison Memorial Prize for 1929 to Dr R P Linstead The prize is given for conspicuously meritorious work in any branch of chemistry, pure or applied, and is to be regarded as an exceptional distinction to be conferred upon a chemist less than thirty years of age who in the opinion of those best qualified to judge had made a notable addition to our knowledge of chemistry The presentation of the prize will be made at the annual general meeting of the Chemical Society on Mar 27

THE Darwin Medal awarded by the Royal Society in 1928 to Dr L Cockayne was presented to him on Aug 7 last at a special meeting of the Canterbury Branch of the Philosophical Institute of New Zealand, held in the Hall of the Canterbury University College, Christchurch, New Zealand, by Dr C C Farr, professor of physics in the Canterbury University College and president of the Philosophical Institute of New Zealand In the course of an address on "Darwin and After Darwin", Dr F W Hilgendorf of the Agricultural College, Lincoln, Canterbury, dwelt upon the great value and significance of the recent researches by Dr Cockayne into hybridism in the native flora of New Zealand, which have proved clearly that Nature is selecting among the members of the hybrid swarms In presenting the medal, Dr Farr remarked that Dr Cockayne is the first to gain a Royal Society Medal by work done entirely in New Zealand Dr Cockayne, in his reply, spoke of his early interest in the plants of his native Yorkshire, and told how the late Mr Robert Brown, the well known bryologist of Christchurch, had advised him, when he first began to work upon the flora of New Zealand, "to leave the authorities alone and go to the plants themselves" Outlining his own work, Dr Cockayne said that he had published 155 botanical papers, all of which touch upon and illustrate variation in plants Only a few years ago, our knowledge of hybrids in New Zealand was quite meagre, whereas now there are known to exist no less than 360 'hybrid swarms' In his opinion, the flora of New Zealand offers a magnificent laboratory for the study of evolution, and he expressed the hope that its problems will ultimately be solved by some worker born and bred in New Zealand itself On behalf of the Philosophical Institute of Canterbury, Mr R M Laing congratulated its only honorary member, Dr L Cockayne, on the award of the Darwin medal He said that Dr Cockayne's work, apart altogether from its scientific value, has resulted in much knowledge of value to horticulture, agronomy, and forestry

IN a further despatch to the *Times*, Sir Hubert Wilkins has added some details about his flight to Charcot Island The most easterly point of the island is in long 73° W, and the latitude of the north coast is five miles south of its charted position The flight evidently confirms the existence of Stefansson Strait between Graham Land and Hearst Land and extends the islands of the Finley group to long 70° W No further information is available regarding Hearst Land and its relation to the Antarctic continent It appears, however, to be Sir Hubert Wilkins' intention to travel by steamer along the pack ice to about long 100° W, making flights to the coast at various points He believes that he may be unable to make his contemplated flight to the Ross Sea owing to the lack of a suitable taking off field in the far south

THE seventh annual meeting of British zoologists was held on Jan 11 in the rooms of the Zoological Society of London, by kind permission of the council of the Society Prof Stanley Gardiner opened a dis-

cussion on the possibility of rendering the zoological experts of one university available for special instruction to the advanced students of another university The committee presented a report on the syllabus of biology in schools, urging the importance of a grounding in animal biology as a preparation for citizenship Mr James Gray recounted the difficulties of importing scientific cinema films and scientific apparatus, it was decided to appoint a subcommittee to consider the hindrances offered to scientific research by the present Customs regulations On the motion of Lord Rothschild, the meeting expressed disapproval of any proposal to convert the existing nature reserves in Great Britain into national parks Dr C M Yonge reported the proceedings of the Barrier Reef Expedition and was congratulated on his success

WE have received Parts 71 72 (combined) of "Type Ammonites", which bring to a conclusion this work started by the late Mr S S Buckman (as "Yorkshire Type Ammonites") a little more than twenty years ago The whole work includes more than 1000 plates, figuring very nearly 800 species of Jurassic ammonites No plates appear in the final part, which, except for the completion of the author's text on the opening page, consists entirely of tables and notes compiled by the editor, Dr A Morley Davies Chief among these is a complete list of the figured species arranged in order of geological sequence according to the detailed hemeral scheme proposed by the author There are also indexes of generic and specific names, bibliographic details, etc This final part is published by the executors of the late S S Buckman, at Southfield, Thame, England (price £1) We understand that a limited number of complete copies of the whole work (Vols 1 7) are still available (price £36), and that incomplete sets can be completed provided they include Vol 3

IN the *Times* of Jan 11 was the account of the sale by auction of the famous mountain landmark in south eastern France, the Puy de Dôme, famous as the scene of Pascal's great experiment with the barometer It was a month after Torricelli's death that Pascal first proposed the experiment of carrying a barometric tube up a mountain and noting the variation Being himself in the north of France, he wrote to his brother in law, Périer, in November 1647, but the experiment was not carried out until Sept 9, 1648, when Périer and his companions found that while at the base of the mountain the mercury stood at 26 in, at the summit it had fallen to 23 in The Puy de Dôme was also one of the heights ascended by Guettard and Malesherbes prior to the former reading his paper on "Certain Mountains in France which have once been Volcanoes" to the Paris Academy of Sciences on May 10, 1752 Last year a syndicate attempted to buy the summit to make it a tourist resort, but the peasant proprietors defeated the attempt, and they have now apparently by a bid of 122,000 francs outbid the Department, hoping thereby to enhance its value still further

SIR RICHARD GLAZEBROOK, formerly Director of the National Physical Laboratory, has been elected an honorary member of the Institution of Electrical Engineers

LORD BLEDISLOE, whose appointment as Governor-General of New Zealand was referred to in our issue of Dec 7, 1929, p 887, has been made Knight Grand Cross of the Most Noble Order of St Michael and St George (G C M G)

A MEMORIAL plaque to the late Sir William Glyn Jones, formerly secretary of the Pharmaceutical Society of Great Britain, who died on Sept 9, 1927, will be unveiled in the Society's examination hall by the Right Hon Christopher Addison, on Wednesday, Feb 5, at 3 P M

THE Secretary of State for the Colonies has appointed Dr Drummond Shiels, M P, Parliamentary Under Secretary of State for the Colonies, to succeed Mr William Lunn, M P, as chairman of the Advisory Committee on Education in the Colonies and of the Colonial Advisory Council of Agriculture and Animal Health, and also as chairman of the Colonial Medical Research Committee

THE Henry Saxon Snell prize of the Royal Sanitary Institute was founded to encourage improvements in the construction or adaptation of sanitary appliances, and is to be awarded by the Council of the Institute at intervals of three years The prize in the year 1930 will consist of fifty guineas and the medal of the Institute, and is offered for an essay on "Improvements in the Sanitary Provisions of Schools" Essays should not be longer than 5000 words and typewritten, must be delivered on or before Aug 30 next, addressed to the Secretary of the Royal Sanitary Institute, 90 Buckingham Palace Road, London, S W 1, from whom further particulars may be obtained

As already announced, the meeting of the British Association this year will be held in Bristol on Sept 3–10, when Sir Thomas Holland will be succeeded in the presidential chair by Prof F O Bower The presidents and recorders of the Sections will be as follows A (Mathematical and Physical Sciences) Dr F E Smith, Mr W M H Greaves, Royal Observatory, S E 10 B (Chemistry) Prof G T Morgan, Prof C S Gibson, Chemical Department, Guy's Hospital Medical School, S E 1 C (Geology) Prof O T Jones, Mr I S Double, Department of Geology, University, Liverpool D (Zoology) Dr W T Calman, Mr G Leslie Purser, University, Aberdeen E (Geography) Prof P M Roxby, Mr R H Kinvig, 36 Oakfield Road, Selly Park, Birmingham F (Economics) Prof T E Gregory, Mr R B Forrester, Inverey, Somerset Road, New Barnet, Herts G (Engineering) Sir Ernest Moir, Mr J S Wilson, 49 50 Parliament Street, S W 1 H (Anthropology) Dr H S Harrison, Miss R M Fleming, Marine Terrace, Aberystwyth I (Physiology) Prof H S Raper; Dr M H MacKeith, Magdalen College, Oxford J (Psychology) Prof C W Valentine, Dr Shepherd Dawson, Hazel Bank, Thorn Road, Bearsden, Dumbartonshire K (Botany) Dr A W Hill, Prof W Robinson, Botanical Department, University College, Aberyst-

wyth L (Education) Right Hon Lord Eustace Percy, P C, Mr G D Dunkerley, 29 Gordon Square, W C 1 M (Agriculture) Dr P J du Toit, Prof G Scott Robertson, Ministry of Agriculture, Welling ton Place, Belfast

THE following appointments have recently been made by the Secretary of State for the Colonies Mr A G G Hill, botanist, Nigeria, to be plant breed ing officer (senior geneticist), Mauritius, Mr N Humphrey, to be agricultural officer, Kenya, Mr L. R Doughty, to be geneticist, East African Agricultural Research Station, Amani, Tanganyika Territory, Mr J P Mead, personal assistant to the conservator of forests, Malaya, to be director of forestry, Malaya, Mr J N Oliphant, conservator of forests, British Honduras, to be deputy director of forestry, Malaya

THE afternoon lectures at the Royal Institution will be resumed on Jan 21 at 5 15, when Dr F W Aston will begin a course of three lectures on Tuesday afternoons on isotopes, on succeeding Tuesdays there will be four lectures by Sir William Bragg on X ray determination of the structure of cellulose and similar substances, and four by Dr Charles Singer on the passage from medieval to modern science On Thursday afternoons, beginning on Jan 23 at the same hour, there are to be two lectures by Dr H A Harris on the growth of children in health and disease, one on Feb 6 by Dr R L Smith Rose on radio direction finding by transmission and reception, and two by Mr T A Joyce on architecture and the industrial arts of Pre Spanish America The Saturday afternoon lectures at three o'clock will include four by Sir Ernest Rutherford on atomic nuclei and their structure Sir William Bragg will give the first Friday evening discourse on Jan 24, on cellulose in the light of the X rays Succeeding discourses will probably be given by Lord Rayleigh, Dr Leonard Hill, Prof A F Pollard, Prof G I Taylor, Mr C Tate Regan, Prof G Elliot Smith, Mr Seton Gordon, Sir Ernest Ruther ford, and others

MOVEMENTS attributed to an earthquake reported to have been felt in Brittany were recorded at Kew Observatory on Jan 9 The first onset was at 19 hr 39 min 49 sec and oscillation lasted about three minutes The disturbance was less than that produced by the earthquake in Jersey on July 30, 1926

THE Royal Institute of Public Health will hold its annual congress at Portsmouth on June 4–9 The scientific work of the Congress will be conducted in five sections dealing respectively with State medicine and municipal hygiene, health in the naval, military, and air services (including tropical diseases), industrial hygiene, women and children and public health, and tuberculosis

BY kind permission of the president and council of the Royal College of Surgeons of England, the human skeletal material collected by the East African Archæological Expedition during the season 1926–27 and 1928–29, will be on view to the public in the Museum of the Royal College of Surgeons, Lincoln's Inn Fields, for one week from Monday next, Jan 20, during the hours 10 5, and on Saturday, 10 1 A type series of the associated stone implements will also be exhibited

THE annual report and statement of accounts for the year 1928–29 of Livingstone College, Leyton, have reached us The College provides instruction in the elements of medicine for those engaged in work in the mission field During the year, 83 students attended the various courses of instruction The College has paid its working expenses during the year and also reduced the deficit of £933 by £117, but additional donations and subscriptions are required to extend the work

THE Rockefeller Foundation, New York, has issued the fifteenth series of "Methods and Problems of Medical Education" This contains a description of the departments and courses of instruction of the Albany Medical College of the Union University and of the Albany Hospital, Albany, New York, with numerous plans and illustrations It is of interest that Dr Sautter, the professor of contagious diseases, expresses the opinion that the cubicle system of treating infectious diseases is satisfactory only if fully trained nurses are employed, and while cheaper than the ward system, the latter, from the humanitarian view point, has great advantages

THE annual report of the South African Institute for Medical Research contains an account of the routine and research work carried out in the Institute during 1929 Trials made of a bacteriophage active against the plague bacillus as a prophylactic or a therapeutic agent have been unsuccessful Dr Pirrie has found that the plague bacillus is dissociable into two variants, corresponding to the normal or 'S' forms and the 'R' forms of other micro organisms Tuberculosis of South African natives appears to be caused by the human type of tubercle bacillus, as 100 strains of the bacillus isolated were all of this type, and bovine sources of infection play little part, therefore, in the causation of tuberculosis among South African natives

THE Medical Research Council has issued a report entitled "Medical Uses of Radium Summary of Reports from Research Centres for 1928 (*Special Rep Series*, No 144 London H M Stationery Office, price 1*s* net) This has been compiled by the Radiology Committee of the Council, which allocated the radium salt entrusted to it by H M Government to various institutions named As in previous years, the reports are grouped under the headings of regions of the body It may be stated in general that the results so far obtained indicate that while the use of radium as an agent for the treatment of localised cancer has considerable chance of success, once the disease has become generalised the use of radium is mainly palliative The Committee emphasises the fact that

radium therapy is a highly specialised type of work to be undertaken only by properly trained persons

A NOTICE appeared in NATURE of Dec 21, 1929, p 944, of "A Challenge to Neurasthenia", by Miss D M Armitage The price given, namely 5s net, is incorrect, the booklet is available at 2s 6d, or 1s in paper covers

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A lecture assistant in the department of chemistry of the University College of Swansea—The Registrar, University College, Swansea (Jan 20) A mathematical master at the Royal Naval College, Dartmouth—The Head master, Royal Naval College Dartmouth (Jan 20) A science master at the Huddersfield College, for Physics and Chemistry—The Director of Education, Education Offices, Peel Street, Huddersfield (Jan 22) A secretary and director of education under the Wigan Education Committee—The Town Clerk and Clerk to the Local Education Authority, Municipal Offices, Library Street Wigan (Jan 22) An engineering assistant at the Building Research Station of the Department of Scientific and Industrial Research, for work in connexion with investigations on Structural Steelwork—The Director, Building Research Station, Garston, Watford, Herts (Jan 23) A lecturer in physiology at St Thomas's Hospital Medical School —The Dean of the Medical School, St Thomas's Hospital, S E 1 (Feb 14) A professor of electrical engineering at King's College, London—The Academic Registrar, University of London, S W 7 (Feb 21) A senior research assistant at the National Institute of Poultry Husbandry—The Director, National Institute of Poultry Husbandry, Newport, Shropshire Civilian education officers in the Royal Air Force Educational Service—The Secretary, Air Ministry, Gwydyr House, Whitehall, S W 1 A full time lecturer at the Portsmouth Municipal College, for the Training of Wireless Operators for the Postmaster General's certificate—The Secretary, Municipal College, Portsmouth A resident research fellow at Lady Margaret Hall, Oxford—The Hall Secretary, Lady Margaret Hall, Oxford A part time laboratory assistant in the department of hygiene and bacteriology of King's College of Household and Social Science—The Secretary, King's College of Household and Social Science, Campden Hill Road, W 8 A laboratory assistant in the physics department of the Cancer Hospital—The Secretary, The Cancer Hospital, Fulham Road, S W 3

Our Astronomical Column

Rotation of the Galaxy—A *Daily Science News Bulletin* of Jan 1, issued by Science Service, Washington, D C, gives a summary of a lecture given by Dr J S Plaskett at Des Moines, Iowa during the meeting of the American Association for the Advancement of Science It had been found by several observers that the stars of *B* type show on the average an outward motion from our system of about 5 km /sec Dr Plaskett showed that this could be explained in large measure by combining the effect of galactic rotation with the fact that a special group of *B* stars in Scorpio and Centaurus show an unusually high speed for stars of this type He gives 9 km /sec as the mean speed of the more luminous *B* stars, and 12 km /sec for the less luminous ones

It may be noted that Dr Plaskett has just been awarded the Gold Medal of the Royal Astronomical Society for his brilliant researches in stellar spectroscopy

Comet Schwassmann-Wachmann (1)—*Beob Zirk*, No 44, contains an interesting note by Dr W Baade of Bergedorf Observatory on this comet It will be remembered that its perihelion passage occurred in May 1925, more than four and a half years ago On Nov 6 last, Dr Baade failed to photograph it, and concludes that it must have been fainter than mag 17 But on Dec 2 its magnitude had risen to 13 5, and it presented the appearance of a planetary nebula some 18″ in diameter It was again photographed on Dec 5, when its nucleus was of mag 14 3, eccentrically placed in a faint nebulosity The sudden change of brightness recalls the remarkable outburst of Holmes's comet in November 1892, repeated on a smaller scale some two months later D'Arrest's comet in 1923 also exhibited an unexpected increase of brightness from mag 14 to mag 11, although the calculated brightness was diminishing But the change in the present case is still more mysterious, owing to the great distance of the comet from the sun It is now not very far inside the orbit of Saturn, where the solar exciting effect must be very weak It would appear that there is some unknown source of energy in the comets themselves to explain these sudden outbursts

Orientation of the Planes of Binary Stars—There have been many attempts to find whether there is any law governing the orientation of the planes of revolution of the binary stars The conclusions have been curiously inconsistent, some observers finding a concentration of the poles of the planes in the plane of the galaxy, others in the pole of the galaxy, others in positions related to the ecliptic or the solar apex Such discordance is not surprising when we note that when the orbits of binaries are determined simply from measures of position angle and distance, there are two possible positions of the orbit plane, one nearer to us on the north side, the other nearer on the south The investigators tried to avoid the difficulty in different manners, but Mr Y C Chang notes in *Astr Jour*, No 932, that it can only be eliminated in the case of those binaries for which radial velocities have been obtained with the spectroscope over a sufficient arc of the orbit He was able to collect the necessary observations for twelve binaries, and has added four more from results obtained at the Yerkes and Lick observatories The resulting poles are deduced and plotted on two diagrams, referred respectively to the terrestrial equator and to the galactic plane Neither diagram shows any evidence of concentration The distribution appears to be a random one

Mr Chang draws the conclusion that the evidence favours the fission theory of generation of double stars, rather than those of stellar appulse, or adjacent nuclei in a primitive nebula These would be likely to show grouping related either to the direction of the streams of stellar motion, or to the plane of the galaxy

Research Items.

Archæology of the San Joaquin Valley, California —A further study of the archæology of the San Joaquin Valley, in this case covering the northern section, has been published by the University of California in the *Publications relating to American Archæology and Ethnology*, Vol 26, No 4 The authors, W E Schenck and Elmer J Dawson, have examined a number of mounds in this section as well as specimens obtained by other collectors, especially the late Mr H H Barr The mounds, the evidence indicates, were not used exclusively for burial, though these occur throughout the strata and in some cases in the substratum Although some of the human bones were scorched, this was probably due to the burial fire, and cremation was not practised Artefacts were burned at the grave Of those associated with the skeletal remains, which were found in large numbers, pipes, pestles, and obsidian blades were sometimes broken or 'killed' Shell ornaments and beads were the objects most frequently found Though pottery was extremely rare, the large number of objects of clay was one of the unique features of the site Baked clay balls were found in profusion These were probably a local invention, as they are not known elsewhere Their use is obscure Their number is perhaps due to the lack of stone in the area, and they may have been used for some such purpose as fire-stones The age of the mounds in some instances may be put at 1800 A D, as is shown by Caucasian objects associated with the finds, but the oldest mound is calculated to be probably not more than fifteen hundred years earlier

Effects of Environment on Twins —Many studies are now being made of identical twins It is well known that such twins show great similarity not only in appearance but also in such details as finger and palm prints The *American Weekly* of Dec 29 last describes recent studies by Prof H H Newman, of the rare cases in which identical twins have been separated in early life, and have grown up in different environments A pair of twin girls born in London were separated at the age of 18 months, one (Olive) growing up in a poor part of Chelsea and the other in an Ontario town under better conditions They differ in height by only an eight of an inch, but Olive weighed nearly ten pounds more than her sister when the latter joined her in Canada Among numerous other similarities they have the same dental peculiarities Mental tests showed marked superiority of the Canadian girl, partly accounted for by her superior schooling and better health in childhood, but her head is also slightly larger Another pair of identical twins grew up, one in Chicago and the other in a small town in Illinois These young men showed the usual marked resemblances The city boy was better educated and held his facial muscles differently, which made him better looking, but both showed the same intelligence That a tendency to criminality is inherited appears to be shown by observations of Prof Lange in Germany He examined the brothers of 428 criminals Where the twin of a convict was of the ordinary fraternal type, he turned out to be criminal only once in 16 pairs, which is about the ratio for ordinary brothers But in 10 out of 13 cases of identical twins both were criminals, and the three exceptions each had an explanation

Micro-Organisms in Candies and Chocolate —A microbiological investigation of these articles has been undertaken at the Institute of Hygiene, Masaryk University, Czechoslovakia (K Drml, *Publications de la Faculté de Médecine*, Brno, Tchécoslovaquie, 1929, T 7, p 45) It is found that humidity and desiccation are the factors which respectively tend to conserve and to destroy the viability of bacteria upon the surface of confectionery It follows, therefore, that the number of bacteria on confectionery kept in sealed glass or tin-plate containers, and also on chocolates wrapped in tin foil, remains stationary for long periods On the other hand, the packing of confectionery in transparent paper or cellulose bags does not hinder the sterilising influence of desiccation and sunlight while affording sufficient protection from contamination after packing It was found that in samples artificially infected, the typhoid and paratyphoid organisms may remain alive for 2 5 weeks, particularly in chocolates packed in tin foil The need for eliminating all chance of infection during manufacture is emphasised, and transparent or translucent cellulose containers are considered to be the best for packing

Fresh-Water Mollusca of Wisconsin —Two substantial volumes, comprising 1000 pages in all, are devoted to the enumeration and description of the fresh-water Mollusca of Wisconsin by F C Baker (*Wisconsin Geol and Nat Hist Survey Bull*, 70), published under the auspices of the Wisconsin Academy of Sciences, Arts, and Letters The contents of many collections, public and private, were studied and special expeditions were made to different parts of the State by the author, but nevertheless there are some districts yet unexplored that might possibly yield additional species Altogether 327 species and varieties are recognised in this monograph, of which 40 are considered new This is a considerable fauna, as may be realised when it is recollected that the British Isles, with double the area, can only show a hundred aquatic species, or, if allowance be made for those trifling varieties so dear to some collector's hearts, a total of some two hundred forms The descriptive text is full, and copious notes are given as to distribution, ecology, etc, while the nomenclature is on the latest approved American pattern The plates, which number 105, are half tone figures from photographs, and quite satisfactory save in the case of those of the smaller species of bivalves There are plentiful and good text figures illustrating anatomical and other details Each volume has its index, while to the whole work is appended a very full bibliography and a glossary, some of the definitions in which, after the manner of such productions, are distinctly quaint

The California Jack Smelt —Mr Francis N Clark describes the life history of the California jack smelt, *Atherinopsis californiensis*, in Contribution No 77 from the California State Fisheries Laboratory (January 1929, *Fish Bulletin*, No 16 Division of Fish and Game of California) He begins by describing the commercial catch statistics (this being one of the minor fisheries of the State) and fishing gear, then proceeds to length measurements, scale studies, and ova measurements, spawning, age, and rate of growth The fish apparently spawn more than once during a spawning season, which occurs from October to March, and individuals are spawning at all times during the breeding season The largest fish was 33 4 cm in length and was probably nine or ten years old Very few attain 30 cm, and the fish are mature at 18-20 cm at about the end of the second year

Pendulum Observations at Sea —In a recent publication ("Theory and Practice of Pendulum Observations at Sea" J Waltman, Jr, Delft), Dr Vening Meinesz describes the later modifications made by

him in the construction at de Bilt of a new recording apparatus to be used for the determination of gravity at sea Meinesz's method, which reduces the time required to compute an observation from several days to a few hours, was first introduced in 1923, and after his first voyage the apparatus was modified It was tested again in 1925 on a voyage to Port Said, and during the spring of 1926 a further improvement was made by suspending the apparatus in gimbals, and it is hoped that the final results of the voyage to Java during the latter part of that year will be published shortly An additional modification has since been introduced, and the improved recording apparatus in its present form is described in the present publication

Latitude Variations in India —As the result of an inquiry from Prof Wegener, the values of astronomical latitudes of stations in India at which observations have been taken several times at considerable intervals were recently scrutinised to see if they gave any evidence of the crustal movements suggested in the Wegener hypothesis The results are published in the *Geodetic Report*, vol 3, 1926–27, of the Survey of India Observations at fourteen stations were examined At some of these the earliest records were more than a century ago Variations range between −1 56″ and +0 90″ Five sets of observations at four stations cover intervals of less than a year, and nevertheless show changes only slightly smaller than other sets covering a much longer period Of the other ten stations, several appear to show increases of latitude between 1800 and 1870, and others show increases only between 1870 and 1927 The figures from two adjacent stations are directly contradictory The only conclusions that can be derived from these data is that the apparent changes are due to errors in observations and that they afford no evidence of continental drift On the other hand, it is pointed out that the figures do not furnish disproof of a drift of the order of fifty feet a century

New Type of Epidiascope —The increased use of visual methods in education has been accompanied by progressive improvements in the design and construction of optical projection apparatus, and the modern epidiascope, which is compact and easy to manipulate, is rapidly superseding the projection lantern A new type of epidiascope embodying several further improvements has recently been put on the market by Messrs W Edwards and Co The apparatus is constructed on the 'unit' principle The episcope is the basic unit and is so designed that the addition of other units, either as permanent attachments or for temporary use, enables the apparatus to be used for vertical projection, for optical bench work, and for the projection of lantern slides, microscopic slides, or kinematograph pictures The reflecting mirror for episcopic projection is placed inside the apparatus and is thus protected from dust, and the possibility of accidental damage is diminished Illumination is provided by means of a 500 watt standard projection lamp If greater intensity is required a second lamp can be easily introduced The instrument is fitted with anastigmat projection lenses and good definition is obtained over the whole picture Demonstrations of the apparatus can be arranged at any time on application being made to Messrs W Edwards and Co, 8A Allendale Road, London, S E 5

Enumeration of Coincidences —A neat method for counting coincident discharges in two Geiger' α-particle counters is described by Dr W Bothe in the first number of the current volume of the *Zeitschrift für Physik* A four electrode thermionic tube is set up with its two grids connected one to each of the Geiger counters The potential impulses set up by the entry of ionising particles into the counters are thus transmitted to the grids, and the latter have in addition a steady negative potential applied to them of sufficient magnitude to prevent the passage of current through the valve to the anode unless the potentials of *both* grids have been momentarily raised In other words, current pulses are recorded in the anode circuit only when the two counters respond simultaneously to the ionising agency Dr Bothe gives some figures to show the very considerable extent to which the labour inherent in the older direct method for detecting coincidences has been reduced by this device, which appears to have an immediate important application in the investigation of the cosmic radiation

Lead Arsenate Sprays —In recent years lead arsenate solutions have been extensively used as insecticide sprays, and a leaflet issued by the U S Department of Agriculture describes experiments by H S Swingle on the effects of such sprays It was found that, at low concentrations of equivalent arsenic content, arsenious and arsenic acids are equally toxic to peach foliage At higher concentrations arsenic acid is the more toxic Arsenic acts as a cumulative poison within peach leaves The minimum concentration of arsenic acid toxic to peach foliage contains the equivalent of 0 0012 per cent of arsenic pentoxide Acid lead arsenates containing less than 0 25 per cent of arsenic pentoxide in water-soluble form gave minimum foliage injury Nothing of practical importance is gained by further reduction in soluble arsenic Lead arsenate cannot be used upon susceptible plants without the addition of some material to prevent burning

Proteins in Brewing —A melancholy interest is attached to a paper recently published in the *Journal of the Institute of Brewing* (35, 532, 1929) under the name of the late Prof S B Schryver Not only was it intended to serve as an introduction to a series of his researches under the auspices of the Institute of Brewing research scheme on the proteins and their relation to the industry of brewing, but also it was dictated from the sick bed and read by proxy, and the discussion was never seen by the author even in manuscript After a discussion of the nature and constitution of the proteins, it is shown that investigation of the large number of unknown factors which determine the rôle of nitrogen in brewing falls under three heads (1) The variations in nitrogen in barley due to differences in soil, climate, and other conditions, (2) the changes produced in barley proteins during malting, (3) the variations in the nitrogenous constituents of wort and their utilisation by the growing yeast In connexion with the third problem, great importance is attached to the fact, originally established by Horace Brown twenty years ago, that a relatively large proportion of the protein matter in wort cannot be utilised by the yeast When in fact these proteins occur in the colloidal state, they may even inhibit growth by settling out with the yeast and choking it As a result of such researches, it may be possible in the future to choose the barley and regulate the malting process so as to reduce these detrimental colloids to a minimum, or alternatively, the colloidal matter may be partly or wholly removed from the wort or prevented from precipitating during fermentation It will be seen that Prof Schryver has provided his successors with a tempting field of possibilities, and it may confidently be anticipated that the seeds he has sown will produce a rich harvest

The Twentieth Annual Exhibition of the Physical Society and the Optical Society.

THE exhibitions of electrical, optical, and other scientific apparatus arranged by the Physical and Optical Societies have grown steadily in interest and importance year by year, and that held on Jan 7, 8, and 9 last was decidedly the most successful of all The exhibition was housed, as usual, in the Imperial College of Science, and although additional accommodation was allotted, the available space was filled to compression with extremely interesting exhibits

An important new section has been introduced, with the object of encouraging craftsmanship in the scientific instrument trade Prizes were offered to apprentices and learners for the best examples of craftsmanship and for the best designs, drawings, or tracings All too little has been done in the past to encourage young instrument makers to take a pride in their art, and it was gratifying to see the high standard attained As the competition was the first of its kind, readers of NATURE may be interested to know the results in detail They were as follows Class *A*, Craftsmanship senior grade (18 21 years) (1) J H Richards (Creed and Co, Ltd), perforator punch block, (2) P D Betteridge (Griffin and Tatlock, Ltd), voltmeter movement, and A Mead (Adam Hilger, Ltd), micrometer eyepiece, honourable mention S W Angel (Negretti and Zambra), Bourdon tube and spindle, and W G Sibley (H Tinsley and Co), six dial resistance box Junior grade (under 18 years) (1) E G Sawyer (Negretti and Zambra), geared movement of quadrant form, (2) R H Brockman (Adam Hilger, Ltd), proof plane of quartz Class *B*, Draughtsmanship senior grade (1) H Downing (General Electric Co, Ltd), (2) E G Baker (George Kent, Ltd) and E Lowings (George Kent, Ltd), honourable mention, A G Haslam (H W Sullivan, Ltd) Junior grade (1) S W Holdstock (George Kent, Ltd), (2) E F Woods (George Kent, Ltd) Scientific progress depends directly on the skill of the instrument maker, and the stimulus provided by a competition of this kind should therefore prove decidedly beneficial

The number of exhibits in the remaining sections was so great that it is out of the question to do justice to them in a short article A full account of the most interesting will be found in the catalogue, which has been printed in a form suitable for binding up with the proceedings of the participating societies Here it is possible only to mention briefly a few items which happened to attract the attention of the writer, and a different observer might well have made a different selection

The section devoted to research and experiment, another feature which has recently been added to the exhibition, is expanding in a satisfactory manner Group *A* comprised nearly a hundred exhibits illustrating recent research Those contributed by the National Physical Laboratory included a wireless oscillator for wave lengths down to 1 5 metres and a direction-finder for wave lengths of 4 10 metres, a 0 00002 ohm standard resistance for direct current up to 20,000 amperes, consisting of 40 parallel water cooled manganin tubes joining two copper discs, to the peripheries of which a number of cables are symmetrically connected in parallel, the arrangement being designed to avoid errors arising from variation of current distribution in the end connexions, and a demonstration of the use of the hot wire anemometer for detecting turbulent flow In the latter a hot wire, in circuit with an amplifier feeding a loud speaker, is situated close to the surface of a stream lined body in a blast of air Normally the loud speaker is silent, but disturbance of the flow by the interposition of a pencil or the like produces loud sounds Messrs R W Paul and B S Cohen showed a series of loud speaker diaphragms made of balsa wood, an extremely light and stiff material the response curves actually measured are found to correspond closely with curves predicted on the assumption that the diaphragms are rigid

In a Kundt's tube excited by a valve driven diaphragm, demonstrated by Prof E N da C Andrade and Mr S K Lewer, the dust particles are found to form sharp and accurately measurable rings at the antinodes, the amplitude of vibration of individual particles can be observed directly (the particles being seen as short lines parallel to the axis of the tube), and the tube is sealed to preserve the purity of the gas (see NATURE, Nov 9, 1929, p 724) A solution has been provided by the British Thomson Houston Co, Ltd, of a problem which must have racked the brains of many youthful electricians, namely, the transformation at high efficiency of direct current supply For this purpose a mercury vapour rectifier having an oxide coated hot filament as cathode and a magnetic control is used This rectifier has several interesting properties and will probably be put to many uses For the purpose of direct current transformation, it is made to commutate the low tension supply, and the resulting alternating voltage, after being stepped up by an ordinary transformer, is rectified to yield a high tension direct current output

A curious experiment on weak suspensions of clay was contributed by the Rothamsted Experimental Station When the solid matter forms a few per cent of the whole, the suspension behaves as a liquid for ordinary stresses, but as an elastic solid for very small shearing stresses, the critical value of the stress increasing rapidly with concentration A viscometer of the rotating cylinder type was demonstrated, the outer cylinder, which contains the clay, being suspended, while the inner revolves For very slow speeds of rotation the torque increases regularly with speed, but when the shearing stress exceeds the critical value a very large increase in the speed makes little difference to the torque The Research Laboratories of the Gramophone Co, Ltd (H M V), and the Marconiphone Co, Ltd, also demonstrated a magnetically controlled mercury vapour relay, and another interesting feature of their stand was a cathode ray oscillograph arranged to show, on a time base, the dying away of a sound picked up by a microphone in the hall, the sound supply being cut off suddenly after a steady distribution of sound intensity had been attained Messrs C E Wynn Williams and Ward showed apparatus for counting the passage of α particles based on the usual principles, but having the unusual feature that the impulses initiated by the passage of the particles are applied to a mechanical counter, the number-cylinders of which are seen to move step by step as the particles emerge

A good deal of ingenuity can be exercised in the devising of lecture experiments and teaching apparatus of an inexpensive type, and this year the section of the exhibition devoted to such matters was very well supported A very fine collection of improvised apparatus was shown by Mr F A Meier, of Rugby, the most striking being, perhaps, that in which a diffraction pattern is formed by means of three steel balls in contact Talbot's bands were produced by Mr A C G Beach (Chelsea Polytechnic) by placing between a spectrometer and an observing telescope an additional slit having half its width occupied by

a strip of celluloid film Paper clips of the 'bull dog' type have often featured in apparatus constructed by hard pressed teachers under the stress of enforced economy, but the usefulness of these fac total objects has been much extended by Mr D G A Dyson by the addition of brass terminals, which facilitate attachment to the steel rods that figure in improvisations of the kind in question Mr J E Calthrop, of East London College, has devised a simple hydrometer for measuring surface tension, it consists of a glass vessel made of two cylinders of different diameters having their axes in line The vessel is loaded with mercury so that it floats vertically with either end uppermost, and the volumes which stand above the surface of the liquid in the two positions differ by an amount which gives the surface tension in absolute units

In the trade section the largest share of attention was attracted by those firms—happily a large and increasing number—which enter into the spirit of the exhibition and contrive to make their stalls scientifically interesting There is still a certain number of firms who are content to set up a kind of shop window full of unedifying boxes with terminals or eyepieces on their outsides, but the more enterprising exhibitors contrived to provide excellent demonstrations or dis assembled instruments and even they were far too numerous for individual mention The Cambridge Instrument Co, Ltd, had, as usual a very fine display of new apparatus Among the instruments which attracted our attention was a seismograph for detecting salt domes and for locating geological faults, it was noteworthy for a delicate and effective application of the toggle principle for multiplying movement The same firm showed a recording colorimeter in which light, after passing through solution the colour density of which varies with time, affects a photo electric cell which controls a thread recorder The current supply is drawn from the mains and ripple is eliminated by an ingenious device, the filament of a triode valve is heated with alternating current, and the anode is supplied through a resistance with rectified current from the same source, fluctuations in the mains vary both the valve impedance and the potential drop in the resistance in such a way that the effects of these variations cancel one another The Ashdown rotoscope, manufactured by Elliott Bros (London), Ltd, for observing objects in periodic motion and measuring their periodicity, is a stroboscope with a useful feature for rendering the view of the object instantaneous, while permitting good apparent illumination the shutters consist of rotating sets of parallel laminæ, so that a good instantaneous view is afforded when the laminæ are horizontal, but a very sharp cut off is effected as soon as the laminæ have rotated through a small angle Among Messrs Hilger's exhibits was a system for spectrographic analysis by Barratt's method Two spark gaps, one having electrodes of known composition, while the other has electrodes of the substance under test, are connected in series so as to take the same current, and the relative intensities of the same spectral line when derived from each of the two gaps are found by means of a photometer of the polarisation type

The M O Valve Co, Ltd, set an excellent example by installing an automatic grid making machine, which was seen in action Nothing is more interesting to visitors than a glimpse of manufacturing processes such as the one thus afforded It is, however, impossible to do more than pick out, more or less at random a few plums from the embarrassingly rich fare provided

Discourses were delivered as follows on Jan 7, Lord Rayleigh on "Iridescent Colours in Nature from the Standpoint of Physical Optics", on Jan 8, Mr S G Brown on "Gyro Compasses for Gun Fire Control", and on Jan 9, when the general public was admitted free, Sir Ambrose Fleming on "Television, Present and Future"

Prize Awards of the Paris Academy of Sciences

AT the annual public meeting of the Paris Academy of Sciences, held on Dec 16, the prize awards for the year were announced as follows

Mathematics —The Francœur prize to Paul Noaillon, for his researches in mathematical analysis and hydrodynamics

Mechanics —The Poncelet prize to Alfred Liénard, for his works on the application of the general theories of mechanics to the problems of electrostatics, electrodynamics, and magnetism, the Henry Bazin prize to Charles Camichel, for his experimental study of eddies in liquids with the aid of metallic particles in suspension

Astronomy —The Lalande prize to Alexandre Véronnet, for the whole of his astronomical work concerning the figure and constitution of the heavenly bodies, the Damoiseau prize to Gaston Fayet, for his memoir on the eccentricities of cometary orbits, the Valz prize to Louis Dunoyer, for his researches on spirit levels and photoelectric cells

Geography —The Gay prize to Ludovic Gaurier, for his work on the lakes of the Pyrenees, the Tchihatchef foundation to Paul Pollacchi, for his French colonial atlas

Navigation —Prize of the Ministry of Marine to (the late) Eugène Émery, for the whole of his work, the Plumey prize to Pierre Clerget, for his improvements in motors for air navigation

Physics —The Gaston Planté prize to Charles Féry, for his work on the theory of the lead accumulator, the Hébert prize to Georges Déjardin, for his researches on ionisation potentials and on the classification of spectral lines of various atoms, the Henri de Parville prize to Marcel Pauthenier, for his work on Kerr's electro optical phenomenon, the Hughes prize to Jean Jacques Trillat, for his researches on molecular orientation made by means of the X rays, the Clément Félix foundation to René de Mallemann, for his work on rotatory polarisation

Chemistry The Montyon prize (unhealthy trades) to Daniel Florentin, for his work on the hygiene of large towns, the Jecker prize between Richard Fosse, for his work in agricultural, biological, and organic chemistry, and Marcel Sommelet, for the whole of his work in organic chemistry, the Cahours foundation between Henri Moureu, for his researches on the tautomerism of the α diketones, and Raymond Quélet, for his work on certain derivatives of benzene, the Houzeau prize to André Travers, for his work in inorganic and analytical chemistry

Mineralogy and Geology —The Delesse prize to Marius Dalloni, for his geological work on northern Spain and Algeria, the Fontannes prize to Alfred Carpentier, for his work on palæobotany, the Victor Raulin prize to Pierre Bonnet, for his geological work on Armenia

Botany —The Desmazières prize to Hubert Bourdot, for his work on the Hymenomycetes of France, the Montagne prize between Pierre Dangeard (1000 francs), for his memoir on *Bangia* and *Porphyra*, and Robert Potier de la Varde (500 francs), for his work in bryology, the Thore prize to Charles Douin, for his work on the

structure of the Muscineæ, the de Coincy prize to Paul Dop, for the whole of his botanical work

Anatomy and Zoology —The Cuvier prize to Émile Topsent, for the whole of his work, the Savigny foundation to Henri Gauthier, for his researches on the fauna of the continental waters of Algiers and Tunis

Medicine and Surgery —Montyon prizes to Gaston Cotte (2500 francs), David and Jean Olmer (2500 francs), Francis Rathery (2500 francs), Honourable mentions (1500 francs) to Charles Joyeux, Camille Simonin, and Mlle Suzanne Guéry, the Barbier prize to Prosper Merklen and Maurice Wolf, for their work on the anatomy and pathology of the reticulo endothelial system, the Bréant prize between Marcel Léger (3000 francs), for the whole of his work relating to plague, and Pierre Lereboullet and Georges Boulanger Pilet (2000 francs), for their clinical and therapeutical manual of diphtheria, the Godard prize to François Aman Jean, for his memoir on the thoracic lumbar region, the Mège prize to René Monceaux, for his memoir on disturbances of the nutritive exchanges in pulmonary tuberculosis, the Bellion prize to Paul Chavigny, the Barron Larrey prize to Joseph Uzac, for his memoir on the medico surgical organisation in the army, the Argut prize to Robert Leroux-Robert, for his memoir on high frequency in oto rhino laryngology

Physiology —The Montyon prize to André Strohl, for his work on the electrical conductivity of the human body, the Pourat prize (in equal parts) between Léon Velluz, for his memoir on the biochemical properties of the ethylene linkings, and Henri Bulliard and Antoine Giroud, for the whole of their work on the epidermis, the Philipeaux prize to Louis Genevois, for work in plant biology, the Fanny Emden prize to César Baudi de Vesme, for the whole of his work on the history of experimental spiritualism

Statistics —The Montyon prize to Maurice Olivier, for a work on the index numbers of the variation of prices

History and Philosophy of the Sciences —The Binoux prize to Prosper Jules Charbonnier, for his work on the history of ballistics, the Henri de Parville prize to Jean Paul Bounhiol, for his work entitled "La Vie"

Medals —The Berthelot medal to Daniel Florentin, Mlle Germaine Marchal, André Travers, the Henri Poincaré medal to Louis de Broglie, for his work on wave mechanics

General Prizes —The prize founded by the State (Grand prize of the physical sciences) to René Dubrisay, for the whole of his work in physical chemistry, the Bordin prize to Henri Bénard, for his work on vortices, the Lallemand prize to Mlle Marie Louise Verrier, for her memoir on the eyes and vision of fishes, the Serres prize to Pol Bouin and Paul Ancel, for their work on the mechanism of the differentiation of secondary sexual characters, the Petit d'Ormoy prize (mathematical sciences) to Paul Montel, for the whole of his work on the theory of functions, the Petit d'Ormoy prize (natural sciences) to Paul Gaubert, for the whole of his mineralogical work, the Jean Jacques Berger prize to (the late) Émile Gérard, for his geological map of the twenty *arrondissements* of Paris, the Saintour prize to Bertrand Gambier, for the whole of his work in infinitesimal geometry, the Lonchampt prize to Pierre Lesage, for his researches on the action of sea salt on the development of plants, the Wilde prize to Léon Brillouin, for his work in physics, the Gustave Roux prize to André Roussel, for his work in mathematical analysis, the Thorlet prize to Adolphe Richard

Special Foundations —The Lannelongue foundation between Mmes Cusco and Rück, the Helbronner-Fould prize to Mme Louis Gentil

Prizes of the Grande École —The Laplace prize to Maurice Borgeaud, the L E Rivot prize between Maurice Borgeaud, Alfred Flinois, Paul Moch, and Édouard Beltrémieux

Foundations for Scientific Research —The Trémont foundation to Charles Frémont, for his work in applied mechanics, the Gegner foundation to Paul Gautier, for his work in connexion with the Lecoq Museum at Clermont Ferrand, the Hirn foundation to M Janvier, for his researches on the Hymenoptera of Chile

The Loutreuil Foundation

Out of 27 applications for assistance from this fund, grants were made in the following 21 cases

(1) *Researches on Specified Subjects* —2000 francs to François Maignon, for the continuation of his researches on the mechanism of venous sclerosis, of anaphylaxy, the rôle of fats in the utilisation of proteins, the influence of the seasons and of the genital glands on basal metabolism, 3000 francs to Gabriel Marotel, for undertaking researches on Douve's disease and its treatment, 2000 francs to Robert Hamy, for the study of the conditions determining the curdling of milk, 2000 francs to Henri Colin, for the purchase of apparatus for micro analysis for use in his researches on the carbohydrates, 5000 francs to Henri Cottier, for research into inheritance in crosses of Asiatic and French cattle, 2500 francs to Claude Gautier, for his researches on the evolution of the total albumenoids of the liver under the influence of nutrition by casein peptone, or by a complex mixture of amino acids, 7000 francs to Edmond Roy Prémorant, for the construction of his diasthypsometer, a geodesic instrument

(2) *The Purchase of Material for Researches* —5000 francs to Émile Demoussy, for the reorganisation of the laboratory of agricultural chemistry at the national agronomic institute, 5000 francs to René Dubrisay, for the laboratory of general chemistry at the Conservatoire national des Arts et Métiers, 10,000 francs to the Museum of Histology of the Hôpital de Saint Louis for the purchase of projection apparatus, 25,000 francs to the Observatory of Ksara, for the purchase of a seismograph, 10,000 francs to the Colony of Tahiti, and 10,000 francs to the Colony of New Caledonia, as a contribution to the creation of a seismological station in each of these islands

(3) *The Purchase of Books* —3500 francs to the National Veterinary School of Toulouse, for completing its French and foreign collection of scientific books and periodicals, 4000 francs to the library of the National Agronomic Institute for the same object, 8000 francs to the library of the École supérieure d'électricité, for the purchase of Wien's treatise on physics (35 volumes), 5000 francs to the society for the encouragement of national industry, for its library

(4) *Voyages and Explorations* —5000 francs to Paul Pallary as a contribution to the cost of a zoological expedition in Syria, 3000 francs to Dr Vellard, to assist his researches in pure and medical zoology in the less known parts of Brazil

(5) *Publications* —5000 francs to the Faune des colonies françaises, 3000 francs to Gaston Fayet, for the publication of the *Bulletin de l'Observatoire de Nice*

The total grants made amount to 128,000 francs

The Victor Noury foundation between Victor Delahaye (3000 francs), for a book on the physical geography of Indo China, V Babet (2000 francs), for his work on the geology of Mayombé, and Mlle Germaine Marchal, for the whole of her work, the Charles Bouchard foundation to Serge Oberlin, for his work (with Dr R Grégoire) on anatomy, the Le Chatelier foundation to Mlle Jeanne Foret, for her researches in inorganic chemistry, the Roy-Vaucouloux foundation to Eugène Wollman, for his work on life under aseptic conditions

Annual Meeting of the Mathematical Association

"GENERAL impressions", said Sir Francis Galton, "are never to be trusted" This general impression (which, if trusted, convicts itself of untrustworthiness) was effectively quoted by Mr B L Gimson in opening the discussion on "Arithmetic of Citizenship" at the annual meeting of the Mathematical Association on Jan 6 and 7 Though later in the meeting 'general tendencies' or 'laws out of focus' were put forward as governing human life, and therefore to be brought within the mathematician's domain through the study of probability and correlation, yet it may be granted that the mathematician above all others should be dissatisfied with general impressions where quantitative data are available Mr Gimson outlined a course of civic arithmetic classified by human interest instead of by arithmetical processes, under such headings as 'Local Finance', 'National Finance', 'Saving, Banking, and Investment', 'Insurance', etc His experiments, carried on for five or six years with classes of boys and girls of the type commonly called unmathematical, have proved that these children can successfully and with keen interest work upon such real life data as are to be dug from "Whitaker's Almanack" or the prospectuses of insurance companies

Those who were inclined to suspect Spherical Harmonic Functions of being excessively abstract found their suspicions agreeably dissipated by Prof S Chapman's lecture on their application to mathematical physics Among the interesting concrete examples which he gave was that of the magnetic field of the earth, expressible as the sum of two convergent series, one of negative powers of the distance from the centre of the earth, giving the part of the field due to extra terrestrial causes, the other of positive powers, giving the part originating from within Work begun in 1600 by Gilbert, and carried on later by Gauss, led to the conclusion that this internal part predominates, but it is only by the use of spherical harmonic functions that 94 per cent of the field is now attributed to an internal origin, 3 per cent to causes residing in the lower air, and 3 per cent to the influence of the sun and other bodies outside the earth In striking contrast to this is the distribution of the responsibility for the diurnal magnetic variation, about 5/7 of which is directly dictated from outside the earth, while the 2/7 which analysis assigns to the inside is probably due, if traced another step towards its source, to internal currents induced by those passing outside A further deduction from this analysis of the earth's magnetic field is that the earth's electrical conductivity, after changing but little within 200 miles of the surface, increases considerably below that depth

The principle of a certain celebrated pump was (rather loosely perhaps) described to an inquirer in these words "You leave out the piston, and compensate for its absence by leaving out the rest of the pump But it works" This also appears to be the principle on which 'The Dalton Plan' works You leave out the class room, the lesson, the chalk, and the teacher without these hindrances the pupil learns as naturally and inevitably as water flows uphill Without (or even with) the proved fact that it sometimes does work, one would call it impossible Mr G W Spriggs, opening the discussion on "Problems of Individual Education, with special reference to Mathematics", gave a most illuminating and well thought out account of his own experiments at the Tiffin Boys' Secondary School, first on the Dalton Plan itself, and later on various modifications of it which his own experience suggested Men of science would feel a certain glow of self satisfaction if they were not above such human weakness, at the news that his principal success has been in sweeping away the atmosphere of the mathematical classroom and substituting for it the spirit of the chemical or physical laboratory, where groups collaborate and discuss instead of sitting chained to desks and books Many will agree that the education of the future may with advantage develop in this direction as economics may towards communism if there is value in the analogy it lies in the lesson that communism, though ideal when it appears as a natural growth, is the most disastrous of failures when imposed by authority

Prof W M Roberts, of the Royal Military Academy, Woolwich began his lecture on "Gunnery and some of its Mathematical Problems" by some quotations from Tartaglia's 'Colloquies", written in 1546 To this Tartaglia is due the solution of the cubic equation for which the charlatan astrologer Cardan appropriated the credit clearly a conspicuously able mathematician, of an intellectual calibre fit to win distinction in any age Nothing brings home to us so startlingly the extent of our debt to Galileo and Newton as the pitiable dynamics of this master mind groping in the darkness of the Aristotelian world Two guns are placed, equidistant from a given wall, one at the level of the foot of the wall, the other as high as its top Both fire so as to hit the top of the wall which hits it harder? "The higher", says the Duke, a practical man, who, like Dr Watson or a Greek chorus, serves as a foil for the sage's wisdom "No," says Tartaglia

The science of weight saveth contrary The pellot weigheth less obliquely and therefore flyeth more heavily out of a piece that lyeth level than when it lyeth crooked" Another consideration is that the pellot which started from the lower and more elevated piece would go farther before hitting the ground, if the wall were removed, than would its rival from the higher and less elevated therefore it contains more force "You have argued well", said the Duke

In 'the cupping effect' Tartaglia is on surer ground The rapid cooling of the hot gas after firing causes a low pressure in the barrel, which in "The Bombardier's Story" whuffled an excessively inquisitive dog into the muzzle, where he served as an unwilling piston "If one shall stick his bare belly against the muzzle, he shall not without great difficulty leave the spot" Members of the Mathematical Association have only themselves to blame if they try this experiment after Tartaglia's and Prof Roberts's warning

Gunnery would have been better in the War if officers, or even if only instructors had understood the theory underlying the practice of the 'long bracket' and 'short bracket' and their connexion with the '50 per cent zone' On the assumption that four times the 50 per cent zone constitutes a 100 per cent zone containing every shell fired at a given elevation, Prof Roberts explained the problem, "Given an observer who can only see whether the shell falls beyond the target or short of it, how to bring the Mean Point of Impact as near as possible to the target in the minimum number of rounds" The answer is well known and is taught to gunners as rule of-thumb the reason for the answer deserves more attention than it had when most of our artillery officers had never seen Woolwich

Dr W F Sheppard in his presidential address dealt with "Mathematics for Study of Frequency Statistics" The future, I believe, will criticise the mathematicians of our time more for their backward

ness in making this subject a part of every mathematician's education than for any of our other defects If the next generation is less open to this criticism than ours, their thanks will be due to a small body of workers among whom Dr Sheppard is a notable figure On this occasion he touched only lightly on frequency distribution, giving his chief attention to interpolation What percentage of those who use, and possibly think they can prove, the binomial theorem know that it arose originally from Newton's researches into interpolation? Yet probably an even smaller percentage can attempt for themselves anything beyond 'straight line' or 'first difference' interpolation Dr Sheppard's paper showed this simple process as a first approximation to various series employed by Newton, Gregory, Euler, Maclaurin, Whittaker, and others, with special emphasis on those 'central difference' formulæ which avoid the unsymmetrical tendency to take more account of observations on one side of the required point than on the other

The final discussion on "The Mathematician in Ordinary Intercourse", after being ably opened by Miss Hilda P Hudson in a speech somewhat critical of her own calling, degenerated into a (fortunately finite) series of addresses on the subject 'Are we remarkably fine fellows?' On this question there was conspicuous unanimity W HOPE JONES

Annual Conference of the Geographical Association

THE annual conference of the Geographical Association was held at the London School of Economics on Jan 2-4, and was attended by between 400 and 500 delegates and members from all parts of Great Britain The publishers' exhibition included an unusually fine display of wall maps and other maps for teaching purposes The outstanding feature of this year's conference was the series of lectures by prominent business and professional men, all of them indicating very clearly the position which geography occupies as a key subject in a liberal education and in a preparation for a variety of careers

Sir Henry Lyons, before handing over the office of president to Mr B B Dickinson (who founded the association thirty seven years ago), dealt in his address with co operation between the geographer and surveyor The surveyor is concerned with the application of accurate physical methods to the measurement of the earth however much the geographer may use the results, surveying is not a branch of geography But the interpretation of the surveyor's results, and especially the selection of matter to be incorporated in maps on a reduced scale, calls for accurate geographical knowledge Col Cochran Patrick, of the Aircraft Operating Company, lectured on air survey, and emphasised the fact that aerial photographs record far more than can be incorporated on a topographical map Many contracts for air survey now stipulate that a finished vertical photograph shall be supplied side by side with the finished map of the same area The use made by archæologists of aerial photographs is well known, and it is interesting to record that the Aircraft Operating Company now employs a forest officer with a long experience in the tropics to assist in the interpretation of forested country Sir John Russell, in his lecture on agricultural developments in South Africa, also stressed the importance of such co operation

REGIONAL SURVEY

No less than three meetings were devoted to different aspects of regional survey work, and of outstanding importance was the discussion on the land utilisation map of Northamptonshire Under the guidance of Mr E E Field, and with the support of Mr J L Holland and the Northamptonshire Education Committee, the whole of Northamptonshire, comprising more than 300 parishes, was surveyed by village school children On the six inch maps of the Ordnance Survey was marked the utilisation of each field—whether arable, grass, woodland, or waste—and the maps so obtained were reduced to the one inch scale and the results published in three sheets by the Ordnance Survey Provided the necessary funds can be obtained, the Geographical Association, following up the success of this pioneer work, proposes to establish a land utilisation survey of Britain, with a central office in London, which shall act as an organising and collecting centre for work of a similar character The support of the Ordnance Survey, of various education authorities, and of agricultural authorities has been promised, and inquiries should be addressed to Dr L D Stamp at the London School of Economics

THE ACTUARY AND THE GEOGRAPHER

Under the title of "The Mortality of Europeans in Equatorial Africa A Study of the Effects of Improved Conditions and Mode of Life", an important paper was read by Mr H E Raynes For life insurance purposes an accurate estimate of probable mortality under tropical conditions is obviously of the greatest importance The most trustworthy figures available relate to government servants, of all ranks and drawn from all classes, employed in West Africa In the period 1881-1897 the death-rates per 1000 per annum were 75 8 for the Gold Coast and 53 6 for Lagos Since that time the improvement has been simply amazing—a consistently rapid decline, interrupted only during the years of the War and immediately after, when many officials were overworked and their leave long overdue The improvement has been specially marked since 1921, and at all ages the death rates in 1925-28 were an improvement on those for 1921-24 In the period 1925-28 the rate varied from 6 5 per 1000 at the age of 25 to 12 1 per 1000 at age 45, dropping to 9 3 for age 50 and over A similar reduction in the 'invaliding rate'—Europeans sent home on sick leave or retired as unfit—is also seen It is often asserted that the resident from the tropics returns home ruined in health and doomed to an early death Records of retired officials from West Africa, however, show in 1926-28 a mortality of 14 6 per 1000 per annum, against the normal for Great Britain of 15

Under modern conditions the European in the tropics has an expectation of life differing almost imperceptibly from that in his native country Deaths are not due to the climate—the 'poisonous atmosphere' of the tropics is a myth—but to lack of precaution against disease Nearly all tropical diseases are preventable, because they are either water borne or insect borne There are three essential factors in modern conditions—segregation (because of opportunities of social intercourse amongst Europeans and a resulting high moral standard), sanitation, and personal hygiene Good, even luxurious, housing and good food are necessities, not luxuries, for the European in the tropics The comparatively high mortality amongst missionaries emphasises the result of a lower standard of comfort

BRITISH NATIONAL PARKS

Dr Vaughan Cornish entered an eloquent plea for a national coastal park, and for reasons of winter climatic conditions, emphasised the suitability of parts of Pembrokeshire or Cornwall

THE NORWICH FOLK MUSEUM

At the conclusion of the London meeting, a party of members visited Norwich at the invitation of the Norwich branch On the Saturday evening they were received by the Lord Mayor (Councillor H Harper Smith), who, in a lantern lecture, outlined the growth of the city, and gave the Association some idea of the wisely planned and actively pursued efforts of the Corporation to preserve the ancient monuments in which Norwich is so rich and to develop the amenities of the city in all directions The reception was held in the Strangers' Hall, a beautiful medieval mansion presented to the city by the late Mr L G Bolingbroke and since utilised for the housing of the first 'Folk Museum' in the country Of parallel interest is the Bridewell Museum, another medieval mansion, and a magnificent example of squared flint work, which houses a collection illustrating local industries There are few cities which can boast a comparable collection so well arranged, and it is hoped that its immense educational value will be maintained by keeping the exhibits up to date as Norwich industries develop

On Sunday the party studied the agriculture of Norfolk between Norwich and Cromer, and the coast erosion and geology between Cromer and Sheringham Monday was devoted to a morning tour of the city, and an afternoon visit to Messrs Colman's mustard works

L DUDLEY STAMP

Annual Meeting of the Science Masters' Association

THE full programme of the thirtieth annual meeting of the Science Masters' Association under the presidency of Prof J C Philip, held at the Imperial College of Science, with evening meetings at King's College for Women, appeared in NATURE of Dec 28 in the Diary of Societies

Twelve years ago the membership of the Association was about 200 and the whole exhibition of traders, publishers, and members was confined to one large room in the London Day Training College To-day the membership is 1560, about 500 of whom attended the recent four days conference The members' exhibit alone, consisting of about 70 pieces of apparatus made in school workshops, much of it original and very ingenious, occupied the whole of the large Physical Chemistry Laboratory of the Imperial College, whilst the traders' and publishers' exhibition was most extensive and instructive, occupying two laboratories, one being the largest in the building This remarkable development of the Association is of course due to the original founders having the vision to throw open the membership to all male teachers of science in secondary schools The friendly contact and fellowship between men with varying types of teaching experience is probably one cause of the particularly bright and stimulating discussions which were an outstanding feature of this year's conference, and show that teachers of science as a body are keenly alive and that school science is in a healthy condition This does not mean that teachers of science are satisfied either with the content of their courses or the methods of teaching They realise that school science is a relatively recent development and as such is of necessity still in the experimental stage—a fact apt to be overlooked by the critics

Many of the members feel, with the president, that after the school certificate stage the tendency has been to make the courses for science specialists too intensive On the other hand, others prefer to keep within the narrower limits on the ground of thoroughness There is room for both types of post matriculation course according to the natural abilities of the pupils and the qualifications of the teacher

The need for closer co operation between university and school is keenly felt by science masters, and during the recent conference the rector of the Imperial College, the president of the Association, and the four professors who initiated the discussion on "Openings for College Trained Men in the Mineral Industry", all made special reference to this

For years science masters have been much exercised in their minds about the value of practical examinations at the school certificate stage Some examining bodies demand them others do not and it is not surprising that science masters are also divided on the question But a general feeling prevails that some form of practical examination is desirable at the school certificate stage This should test the ability to do *practical* work and not *theoretical* work or *mathematics* The joint discussion with the Physical Society on "Examinations in Practical Physics" was noteworthy, in that a new method of examining practical work was put forward by Dr L F Richardson and Mr R S Maxwell, who call it the 'pantopiric' method In it a large number of simple experiments are to be done in, say three hours, the candidates moving round like the members of a family coach every time a bell is rung Mr Meier, of Rugby School, mentioned that he had tried this with a class, setting six short experiments to be done in two hours and he was convinced that this method, combined with a practical examination in which all the candidates answered one and the same question in three hours, gives a trustworthy method of testing practical work

The discussion on broadcasting which followed the specimen lesson on "Liquids", given by Mr A F Walden and broadcast by the B B C from an adjacent temporary studio, elicited the fact that there is a great divergence of opinion on the value of broadcast lessons in science It was agreed that broadcasting might be utilised to bring boys and girls into touch with recent developments by enabling them to listen to accounts broadcast by the actual discoverers A resolution was passed that "This Association suggests that broadcasting is not a suitable medium for the science lesson, but recognises that it might be of use in presenting lectures on general science subjects at a time outside the ordinary school time table"

The past neglect of the teaching of biology in the schools has been partly owing to the fact that physics and chemistry developed earlier and that these subjects lend themselves more readily to laboratory treatment, partly also to the fact that biology should be first of all an outdoor study, and this raises time table difficulties seldom appreciated by headmasters The well attended discussion on "School Certificate Biology", at which the syllabus printed in last week's NATURE was discussed, directed attention to the fact that teachers of the subject work under very varying conditions in regard to time allowance, laboratory accommodation and assistance, money available, etc, making common agreement on a syllabus difficult This could be overcome by schools sending their own

syllabuses for approval by the examiners Resolutions were passed that papers on biology should not include questions in pure chemistry and physics, that there should be no separate practical examination, that in many schools definite field work is at present impossible, that biology should be a subject which ranks for matriculating purposes on the same footing as other subjects, and that the course should be primarily for general education purposes

The retiring chairman, Mr W J Gale, handled the meetings with his usual skill In previous years he has rendered the Association excellent service, first as a member of the committee and later as secretary The chairman for 1930 is Mr F Fairbrother, of the Cedars School, Leighton Buzzard, and the new president is Sir Charles Grant Robertson, principal of the University of Birmingham, where the next meeting is to be held

University and Educational Intelligence

BRISTOL —Dr R J Brocklehurst has been appointed to the chair of physiology Dr Brocklehurst took first class Hons Schools at Oxford, and was assistant in physiology, at first part time, then whole time, at St Bartholomew's Medical College in 1925–26 He was awarded a Radcliffe Travelling Fellowship from Oxford, with which he went to America and Germany from 1926 until 1928, returning to take up a post as senior lecturer at University College, London, in August 1928 His new appointment dates from Aug 1 next

LEEDS —Plans have now been approved for the new building to accommodate the Department of Chemistry—Inorganic, Organic, and Physical This building, stretching, when completed, from the Physics Department to Woodhouse Lane, will, together with the mining block at right angles to it, form the north elevation of the new scheme The east elevation will run alongside Woodhouse Lane, for a distance of about 180 feet, and at its lower end another wing, containing a number of large laboratories, will reach back a distance of 240 feet towards the physics building and will form the southern side of the rectangle of which the complete building will consist The erection of certain portions of the chemistry block is being postponed, but even so the building shortly to be started will have a floor space of some 95,000 square feet

THE Board of Governors of the Hebrew University in Jerusalem has authorised the various science departments and institutes to conduct formal courses in biological sciences The establishment of a School of Tropical Medicine has also been approved The School is to be in connexion with the proposed medical centre in Jerusalem, which is being planned jointly with the American Jewish Physicians' Committee and the Hadassah Medical Organisation Dr S Adler has been promoted to be professor of parasitology and director of the Department of Parasitology at the University, and he has been granted twelve months' leave in order to carry out investigations on kala azar for the Royal Society Dr A Fraenkel, formerly professor of mathematics at the University of Kiel, has been appointed professor of mathematics in the Einstein Institute of Mathematics at the University, and Dr M Felete has been made associate professor of mathematics A special course in advanced bacteriology for graduate students is being given by the Department of Hygiene

Historic Natural Events.

Jan 20, 1607 Severn Floods —Stow records that "the waters rose above the tops of the houses", and the event is commemorated by a painted board in the church at Kingston Seymour The flood came suddenly, many persons were drowned and much cattle and goods lost, the water in the church was five feet high and lay on the ground about ten days The floods extended along the coast for about 20 miles and reached a depth of 12 feet in places The East Anglian fens were widely flooded by the same storm, and in Romney Marsh the sea came in so "outrageously" that it did not seem as if the area could ever be reclaimed

Jan 20, 1838 Great Cold —On Jan 7 a very severe frost set in and continued a month Jan 20 is described as the coldest day of the century in London, temperature fell to $-4°$ F at Greenwich, $-13\frac{1}{2}°$ F at Beckenham, and $-14°$ F at Walton near Claremont

Jan 21–22, 1904 Hurricane in Fiji —A violent hurricane struck the eastern part of the Fiji Islands, probably coming from north of east, recurving near the group and passing away to the south east Many houses and coco nut trees were destroyed, and the lowlands were flooded six feet above high tide mark

Jan 22–24, 1879 Glazed Frost —At Fontainebleau and Orleans rain fell steadily for three days at a uniform temperature of 27° F, freezing as it fell A layer of ice an inch thick formed on the ground, while the branches and twigs of the trees and the telegraph wires were covered by shells of ice of the same or greater thickness

Jan 23, 1556 Great Earthquake —The Chinese earthquake of this date, the most destructive in human life of all known earthquakes, was especially severe in the provinces of Shensi and Shansi In some places, houses and parts of cities sank into the earth More than 830,000 persons were killed

Jan 23, 1855 Great Earthquake —The earthquake that occurred on Jan 23 in 1855 was one of the strongest of New Zealand earthquakes, having disturbed an area of about 360,000 sq miles The earthquake is remarkable for the wide spread changes of elevation that accompanied it A tract of land in the southern portion of the North Island, about 4600 sq miles in area, was raised from 1 to 9 feet, the greater amount being reached along an old fault for a distance of 90 miles along the foot of the Remutaka Mountains In the South Island, the ground was usually depressed from 1 to 5 feet, though over a smaller area

Jan 23, 1895 Thunderstorm and Squall —Shortly before 10 A M, intense darkness and thick fog came on suddenly in London, followed abruptly by a sharp thunderstorm with a heavy shower of hail, while temperature dropped 5° F and the wind rose suddenly from nearly calm almost to gale force The storm was traced across England from Leeds to Sussex, at Bramley near Guildford there was heavy snow and great destruction of trees The thunderstorm was followed by a severe frost

Jan 24, 1666 Wind Storm —Pepys records that "It was dangerous to walk in the street [of London], the bricks and tiles falling from the houses that the whole streets were covered with them, and whole chimneys, nay, whole houses in two or three places, blowed down But, above all, the pales on London Bridge on both sides were blown away, so that we were fain to stoop very low for fear of blowing off the bridge We could see no boats in the Thames afloat,

but what were broke loose, and carried through the bridge, it being ebbing water And the greatest sight of all was, among other parcels of ships driven here and there in clusters together, one was quite overset and lay with her masts all along in the water, and keel above water "

Jan 24, 1684 Great Frost—Under this date Evelyn wrote "The frost continuing more and more severe, the Thames before London was still planted with boothes in formal streetes, all sorts of trades and shops furnished and full of commodities even to a printing presse Coaches plied from Westminster to the Temple, and from several other staires, to and fro as in the streetes, sleds, sliding with skeetes, a bull baiting, horse and coach races, puppet plays, and interludes, cookes, tipling, and other lewd places, so that it seemed to be a bacchanalian triumph, or carnival on the water" This frost continued from the beginning of December to Feb 5, and according to Maitland's 'History of London' a whole ox was roasted on the ice near Whitehall On the Mendip Hills the snow was more than six feet deep in places and people were buried, some of it still remained at midsummer This was the winter described in "Lorna Doone"

Jan 24, 1926 The Largest Sunspot—On this day the largest sunspot seen in recent years (certainly since 1874 when the Greenwich photographic series was instituted) passed across the sun's central meridian The spot, complex in structure, was about 70,000 miles in length and occupied an area of nearly 4000 millions of square miles This region of the sun was active in the preceding December, when a large spot, only slightly inferior to the great spot of January, was also easily seen with the naked eye On Jan 25 and again on Feb 22 when the spot had diminished, brilliant gaseous eruptions were observed spectroscopically The region was marked throughout by a great extent of bright faculæ which persisted for more than six months A magnetic storm, presumably related to this active solar region, took place on Jan 26-27, and was followed one synodic solar rotation later by another on Feb 23 25

Jan 25, 1757 Damage by Lightning—Above 20 feet of the upper part of the spire of Lostwithiel Church, Cornwall, were thrown down and dispersed in all directions, and some pieces were found at the distance of 200 yards The vane was thrown down and bruised, its socket being rent open "as if it had been burst by gunpowder, and in such a manner as could not well be occasioned by the fall"

Societies and Academies

LONDON

Royal Meteorological Society, Dec 18—**J Edmund Clark and I D Margary** Floral isophenes and isakairs It is now possible to compare the annual isophene map with the average map and to prepare from it a map showing for that year the variations from the average in all parts of the British Isles Lines are drawn through points of equal variation defining areas of real earliness or lateness and are called 'isakairs' (equal unseasonableness) Maps so prepared are more instructive than the original isophene maps, for these are based on the original observations, which are always dependent on altitude, latitude, etc, in addition to the changing weather factors In the isakair maps these constant influences are removed and the relation of weather to plant growth can thus be more readily followed Isakair maps have been prepared for every year from 1891 They show the general distribution and degree of earliness and lateness in the first eight months of each year, and form a unique series for such information —**Sir Gilbert T Walker** On the mechanism of tornadoes The prevailing idea that the area of a tornado is roughly vertical has been opposed by Wegener, who maintained that it is horizontal In this paper it is urged that while Wegener's evidence against a vertical axis is conclusive, he does not provide an adequate explanation of a horizontal direction, and that the rotation of the earth will, when convergence occurs, set up a spin parallel to its axis This view is supported by the almost universal anti clockwise rotation of tornadoes in the northern hemisphere and, in general, by the photographic evidence —**E W Bliss** A study of rainfall in the West Indies The rainfall in the eastern islands of the West Indies is related to the circulation of the North Atlantic during the months March to May preceding, and is deficient when the circulation is more vigorous than usual, there is a close relationship with temperature in the Cape Verde Islands, and low temperatures tend to be followed by deficient rainfall In addition, the rainfall in this part of the West Indies belongs to the first group of the southern oscillation

Linnean Society, Dec 19—**Dame Helen Gwynne-Vaughan and Mrs H S Williamson** A contribution to the study of nutritive heterothallism In *Humaria granulata* a coprophilous member of the Discomycetes, nutritive heterothallism is associated with the presence of a functional oogonium The spores are incapable of germination until five months after they are shed, they remain viable for a year or more Single spore cultures produce normal archicarps, but these fail to form ascogenous hyphæ In about 50 per cent of cases fruits develop where two monothallic strains meet The strains are of two kinds, + and − Since each produces oogonia, the difference between them cannot be sexual Mycelial fusions are common, when they take place between + and strains, the oogonia in the neighbourhood form ascogenous hyphæ and develop into fruits Their asci contain both + and − spores, showing that fusion of + and nuclei takes place **F Howard Lancum** On the eviction method of the cuckoo Photographs of the process were secured last summer illustrating the various stages The average time taken by young cuckoos to effect an eviction is three and a half minutes In the case photographed although the cuckoo ejected the egg many times during the morning, in only one instance did it take longer than twenty seconds to do so The photographs showed that the cuckoo insinuated a wing underneath the egg and tilted it inward on to its hollowed back where it was held by the bird s wings and backward tilted head The egg is then pushed up the wall of the nest, the cuckoo meanwhile turning its back to it and maintaining a firm grip on the nest material with its feet, The throwing out movement commences by the cuckoo pushing the egg out backwards with its outspread wings, and finishes with a very vigorous push This cuckoo evicted the same egg (which was replaced on each occasion) fifteen times in an hour The strength and persistence of so young a bird (approximately thirty six hours old), which could repeatedly evict an egg nearly as heavy as itself, climbing an almost perpendicular wall to do so, were remarkable

PARIS

Academy of Sciences, Dec 9—**Gabriel Bertrand and L Silberstein** The relative importance of sulphur and phosphorus in the nutrition of plants It has been proved in earlier communications that determinations of sulphur and phosphorus in the ash of plants

is liable to give erroneous figures for the proportions of these two elements present in the plant, owing to variable losses on ignition Analyses avoiding this source of error are therefore given In estimating the sulphur requirements of a soil, regard must be had to the fact that considerable proportions of it may be masked by the presence of barium Sulphur must be considered as an element to be taken into account in the manurial treatment of the soil —**E Mathias** Contribution to the study of fulminating matter Globular lightning forming holes in the ground —**A Demoulin** The theory of networks —**H Krebs** The deformation of surfaces —**Mandelbrojt and Gergen** Functions defined by a series of Dirichlet —**D S de Lavaud** The variations of sensibility of self tightening brakes on motor vehicles —**H Mineur** The Keplerian movement disturbed by a field of external gravitation —**P L Mercanton** The true height of the Beerenberg of Jan Mayen The values obtained for the height of this mountain by different observers show large variations Barometric observations in 1921 gave 2276 metres direct measurement with a base line of 1062 metres gave 2274 metres Hence the map due to the Austrian expedition of 1882-83 requires correction in this and in other distances found in error —**A Gruvel** A fishery map of a part of the western coast of Morocco —**T Takéuchi** Machines which work between two radiant sources —**A Zmaczynski and A Bonhoure** The boiling point of water as a function of the pressure A development of the apparatus devised by W Swietoslawski for measuring the boiling points of water under different pressures The two electrical resistances employed were standardised over the range 0° 200° C at the Bureau International des Poids et Mésures Over the pressure range 683 832 mm of mercury, the results found were intermediate between the results of Holborn and Henning and of Chappuis, the concordance with the observations of the latter being close —**A Guillet** The use of a galena detector in measurements worked with a variable current —**Stefan Vencov** The hydrogen spectra obtained by electronic shock in a mixture of hydrogen and mercury vapour —**Adolfo T Williams** Spectral terms and chemical valency —**R Lucas and Mlle D Biquard** The influence of temperature and of solvents on the rotatory powers of active substances Data for the rotatory power of *l* fenchone, *d* cyanocamphor, *d* anisylcamphor, and dimethylmalic ester at various temperatures and also in different solvents In these cases it is not possible to account for the variations of the specific rotatory power by the hypothesis of the existence of only two active forms —**Georges Fournier and Marcel Guillot** The radiation responsible for the raising of the absorption curves relative to radium $(D+E)$ —**F Bourion and E Rouyer** Boiling point study of the molecular equilibrium of resorcinol in solutions of calcium chloride —**M Bourguel and Mlle V Gredy** The mechanism of catalytic hydrogenation —**H Pélabon** The action of iodine vapour on phosphorus vapour The volatility product —**E Herzog and G Chaudron** The alteration of the mechanical properties of sheets of duralumin after corrosion by sea water The pinholes produced in the duralumin by attack by sea water reduce the elongation, but do not sensibly reduce the breaking load —**André Job and Georges Champetier** The fixation of acetylene by phenylmagnesium bromide in the presence of ferric chloride —**G Dedebant** Mathematical contribution to the analysis of the field of pressure —**C Dauzère** The formation of electrical charges in storms A discussion of Simpson's theory of rain, with special reference to the cause of the positive electrical charge —**A and G Hamel** The heterogamy of *Lola lubrica* (Cladophoraceæ) —**Paul Dop** Two new genera of Bignoniaceæ of Tonkin —**N Wagner** The evolution of the chondriome in the seeds of *Phaseolus multiflorus* —**Jean Mercier** Observations on the *Psammechinus miliaris* of the bay of the Seine —**Mme Y Khouvine, E Aubel, and L Chevillard** The transformation of pyruvic acid into lactic acid in the liver

SYDNEY

Linnean Society of New South Wales, Nov 27 —**F H S Roberts** A revision of the Australian Bombyliidæ (Diptera) (Pt 3) This paper deals with the lesser subfamilies —**R Broom** On some recent new light on the origin of the mammals Additional light is thrown on the problem by a recently discovered specimen from Ladybrand, Orange Free State, from the Cave Sandstone, of Rhaetic or Lower Jurassic age The new animal is a small mammal like creature about the size of a rat, but with relatively large head and a long tail Together with *Karoomys, Pachygenelus* and *Tritheledon*, it is placed in the new sub order —**W F Blakely** A further contribution to our knowledge of the flora of New South Wales This paper deals with the description of six new species of plants, one of each of the following genera *Correa* (Rutaceæ), *Bertya* (Euphorbiaceæ), *Lasiopetalum* (Sterculiaceæ), *Kunzea* (Myrtaceæ), *Prostanthera* (Labiatæ) and *Goodenia* (Goodeniaceæ) —**W L Waterhouse** Australian rust studies (Pt 1) Teleutospore germinations of *Puccinia graminis tritici* E and H occur over a more extended period than had been previously determined The æcidial stage has been produced repeatedly, but on no occasion by *P graminis tritici* 43 Protound alterations in the reactions produced in seedlings by forms of *P graminis tritici* and other rusts may be brought about by altering the environmental conditions in the plant house In Australasia there have been found seven naturally occurring physiological forms of wheat stem rust, and five of oat stem rust, together with two forms of *P triticina* Certain grasses have been shown to be important hosts of cereal rusts Evidence has been obtained pointing clearly to the fact that rusts over summer in the uredospore stage on 'volunteer' cereals as well as on grasses —**A L Tonnoir** Australian Mycetophilidæ Synopsis of the genera A review of the Australian Mycetophilid fauna to date A list of the genera is given, ten being described as new and the total recorded for the different States being brought to forty seven A peculiar adaptation of the palpi as prehensile organs in one species is described, as well as a case of mimetic resemblance of a Mycetophilid to a Hymenopteron

WASHINGTON, D C

National Academy of Sciences (*Proc*, Vol 10, No 10, Oct 15) —**P W Bridgman** (1) On the application of thermodynamics to the thermo electric circuit By a rearrangement of the argument, the equations of Kelvin for this circuit can be deduced rigorously from thermodynamics without assuming the justifiability of neglecting the effect of necessary irreversible processes —(2) On the nature of the transverse thermo magnetic effect and the transverse thermo electric effect in crystals There is a fundamental difference in sign in the relations connecting the Ettingshausen with the Nernst coefficient and their crystal analogues —**F Zwicky** On the red shift of spectral lines through interstellar space A qualitative, theoretical discussion of a new effect of masses upon light which is a sort of gravitational analogue of the Crompton effect It offers an explanation of the high receding velocities of very distant nebulæ —**E L Hill** Relative inten

sities in nuclear spin multiplets A theoretical discussion —M S Vallarta On Einstein's unified field equations and the Schwarzschild solution —Charles E St John Elements in the sun Of the 92 possible elements, 90 have been found in the earth and 58 in the sun's atmosphere There are many faint lines and several strong ones in the solar spectrum as yet unidentified Some of the strong lines are probably due to common elements, and since corresponding lines are not produced in laboratory, their presence suggests exceptional conditions of excitation —Alfred J Lotka Biometric functions in a population growing in accordance with a prescribed law —J L Walsh Boundary values of an analytic function and the Tchebycheff method of approximation N Wiener and M S Vallarta On the spherically symmetrical statical field in Einstein's unified theory a correction

Official Publications Received.

British

Canada Department of Mines Mines Branch Memoir 157 Preliminary Report on Woman River and Ridout Map Areas Sudbury District Ontario By R C Emmons and Ellis Thomson (No 2191) Pp ii+80 10 cents Memoir 159 Bear River and Stewart Map Areas Cassiar District B C By G Hanson (No 2197) Pp iv+84 20 cents (Ottawa F A Acland)

Canada Department of Mines National Museum of Canada Bulletin No 56 Annual Report for 1927 Pp 107 (Ottawa F A Acland)

The Journal of the Institution of Electrical Engineers Edited by P F Rowell Vol 68 No 396 December Pp 96+xxxviii (London E and F N Spon Ltd) 10s 6d

The Journal of Dairy Research Edited for the Dairy Research Committee of the Empire Marketing Board by Dr R Stenhouse Williams Vol 1 No 1 November (Published half yearly) Pp 110 (Cambridge At the University Press) 10s net

Annals of the (Mededellingen van het) Transvaal Museum Vol 13 Part 3 18 December Pp 123 215 Vol 13, Part 4, 18 December Pp 127 418 (Cambridge Printed at the University Press)

Catalogue of the Twentieth Annual Exhibition of Electrical, Optical and other Physical Apparatus January 7 8, and 9, 1930 Pp 159+xxxii (London The Physical Society and the Optical Society)

The Royal Air Force Quarterly embodying also the Royal Australian Air Force Royal Canadian Air Force New Zealand Air Force and South African Air Force Edited by Squadron Leader C G Burge Vol 1 No 1 January Pp xlviii+284+21 plates (London Gale and Polden Ltd) 7s 6d net

British Industries Fair 1930 Olympia London W 14 February 17th to 28th Organised by the Department of Overseas Trade Special Overseas Advance edition Pp xvi+370+Ad 174+Ad xx (London Department of Overseas Trade)

Transactions of the Institute of Marine Engineers Incorporated Session 1929, December Vol 41 Pp 787-883 (London)

Journal of the Chemical Society December Pp v+2661 2981+x (London)

Conference of Empire Meteorologists 1929 Agricultural Section 1 Report Pp 16 1s net 2 Papers and Discussions Pp 308 1s net British Agricultural Meteorological Scheme Observers Handbook Pp 34 (London Ministry of Agriculture and Fisheries)

The South Eastern Naturalist and Antiquary being the Thirty fourth Volume of Transactions of the South Eastern Union of Scientific Societies, including the Proceedings at the Thirty fourth Annual Congress held at Brighton, 1929 Edited by A F Ravenshear Pp lxiv+110 (London) 5s net

Foreign

Ministerio da Agricultura Industria e Commercio Annuario publicado pelo Observatorio Nacional do Rio de Janeiro para o anno de 1930 (Anno 46) Pp xvi+296 (Rio de Janeiro)

Publications of the Allegheny Observatory of the University of Pittsburgh Vol 7 No 3 Photographic Photometry with the Thirty inch Thaw Refractor The Light Curves of Sixteen Eclipsing Variables By Frank C Jordan Pp 125 193 (Pittsburgh Pa)

Union Géodesique et Géophysique Internationale Section de Magnétisme et Électricité terrestres Bulletin No. 7 Comptes rendus de l'Assemblee de Prague, September 1927 Imprimés par les soins de Ch Maurain Pp xii+209 (Paris Les Presses universitaires de France)

Suomen Geodeettisen Laitoksen Julkaisuja Veroffentlichungen des Finnischen Geodätischen Institutes No 12 Über die Elliptizitat des Erdäquators Von W Heiskanen Pp 18 (Helsinki)

University of California Publications in American Archaeology and Ethnology Vol 27 A Grammar of the Wappo Language By Paul Radin Pp viii+194 (Berkeley Calif University of California Press London Cambridge At the University Press) 2 50 dollars

Smithsonian Miscellaneous Collections. Vol 81 No 14 Prehistoric Art of the Alaskan Eskimo By Henry B Collins, Jr (Publication 3023) Pp 52+24 plates. Vol 82 No 8 The Radiation of the Planet Earth to Space By C G Abbot. (Publication 3028) Pp 12+2 plates (Washington, D C Smithsonian Institution)

U S Department of Commerce Bureau of Standards Miscellaneous Publication No 102 Annual Report of the Director o the Bureau of Standards to the Secretary of Commerce for the Fiscal Year ended June 30, 1929 Pp iv+51 (Washington, D C. Government Printing Office) 10 cents

Spisy vydávané Přírodovědeckou Fakultou Masarykovy University Čís 109 Étude de surfaces dont une droite canonique passe par un point fixe Par Josef Kaucký Pp 3 Čís 110 Generis Trigonella revisio critica II Scripsit G Sirjaev Pp 97 Čís 111 Iter Turcico Persicum Pars 1 Plantarum collectarum enumeratio (Gramineae Cryptogamae) Scripsit Dr Fr Nábělek Pp 42 Čís 112 Příspěvek ke studiu adičních sloučenin organických zásad se solemi těžkých kovů (Contribution à l'étude des composés d'addition des bases organiques avec les sels des métaux lourds) Napsali J V Dubský a A Rabas Pp 12 Čís 113 Severní pokračování devonského pruhu Šternbersko benešovského ve Slezsku (Continuation septentrionale de la zone dévonienne de Sternbeck Benesov en Silesie) Napsal Dr Jan Stejskal Pp 31 Čís 114 Příspěvek k analytickému studiu reakcí oximů (Contribution à l'étude analytique des réactions des oximes) Napsali J V Dubský a M Kuraš Pp 43 (Brno A. Píša)

Catalogues

The Salermo Process Industrial Fuels from Coal by Low Temperature Distillation Pp 57 (London Salermo Ltd)

Catalogue of Fine Chemical Products for Laboratory Use including Organic and Inorganic Chemicals Analytical Reagents Standard Stains, Indicators (January 1930) Pp 190 (London The British Drug Houses Ltd)

A List of Publications and Remainders Pp 128 (London Bernard Quaritch Ltd)

Diary of Societies

FRIDAY, JANUARY 17

LONDON SOCIETY (at Royal Society of Arts) at 5 —F W Parker London's Parks and Open Spaces

ROYAL SOCIETY OF MEDICINE (Balneology Section) at 5 —Dr V Coates Tissue Reaction in Rheumatic Disorders with Particular Reference to Subcutaneous Nodules

BRITISH INSTITUTE OF RADIOLOGY (Medical Members) at 5 —Radiology in Bone and Joint Diseases

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University) at 6 —Prof E C C Baly The Activated Sludge Process for Sewage Disposal

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester) at 7 —W Kershaw Faults in Textiles

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting) at 7 —T Walley The Pooling of Experience —a Function of the Institution

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting) at 7 —P D Johnston Photographic Conventions

ELECTRICAL DEVELOPMENT ASSOCIATION (at Royal Society of Arts) at 7 30 —C H Smith Domestic Hot Water

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7 30 —G Andrew Marshall London's Water Supply

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynaecology Section) at 8 —Dame Louise McIlroy and Miss Iris Ward Three Cases of Imperforate Hymen occurring in one Family Dr J H Hannan Zondek Aschheim Tests for Pregnancy —Prof J P Maxwell Further Studies in Osteomalacia.

ROYAL SOCIETY OF MEDICINE (Electro Therapeutics Section) at 8 30 —P Anderson Cutting Currents

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Local Section of Institute of Chemistry) (at Thomas Café Swansea) —J F J Dippy The Geochemistry of Coal and the Natural Hydrocarbons

SOCIETY OF DYERS AND COLOURISTS (London Section) —H Clayton Lake Colours—Manufacturer and Users

SOCIETY OF DYERS AND COLOURISTS (Scottish Section) —J G Grundy Colours Suitable for Hosiery and Tweeds

PAPER MAKERS ASSOCIATION (Technical Section—London Division) (at Connaught Rooms Great Queen Street, W C)

PAPER MAKERS ASSOCIATION (Technical Section—Northern Division) (at Engineers Club Manchester).—T T Potts The Permeability of Paper to Air

SATURDAY JANUARY 18

PHYSIOLOGICAL SOCIETY (at King's College) at 3 —Prof J Barcroft and J J Izquierdo The Effect of Temperature on the Pulse Rates of the Frog and Cat respectively —Prof J Barcroft and F Verzar The Effect of Temperature on the Pulse Rate of Man —L E Bayliss and A R Fee A Flow Recorder and Automatic Pump Control —Prof J Mellanby The Isolation of Prothrombase from Mammalian Blood.—Prof R J S McDowall Vagus Restraint as a Rebound Phenomenon —H W Kinnersley and Prof R A Peters Local Lactic Acidosis Accompanying Symptoms of Opisthotonus in the Pigeon —F R Curtis Adrenaline and Related Amines —S Wright Action of Ergotamine on Vasomotor Reflexes —C Heymans and J J Bouckaert Sinus Caroticus and Respiratory Reflexes Cerebral Blood Flow and Respiration, Adrenaline Apnoea —R C Garry Amytal and the Inhibitory Action of the Vagus on the Heart —J A Hewitt Protozoan Parasites in Human Heart Muscle B Sarkar The Use of Iron and Tannic Acid as a Tissue Stain —A D Macdonald and E D McCrea Observations on the Actions of the Nerves to the Bladder —*Demonstrations* —Prof R J S McDowall (*a*) The Use of the Vertebral Clamp (*b*) Central Sympathetic Stimulation (*c*) A Convenient Method of Obtaining a Low Potential Current for Class Purposes (*d*) On the Making of Tambours —Prof R J S McDowall and A Shore The Action of Adrenaline on Perfused Pulmonary Vessels —B Finkleman A Simple Inhibitory Nerve Smooth Muscle Preparation —F R Curtis The Interaction of Adrenaline and Ephedrine —S Wright and H A Bulman Intestine of Cat following X Radiation —M Pratt and E B Wright Quantitative Estimation of Photosynthesis —Elizabeth C Eaves The Fields of Vision for Colours of Normal and Colour blind Students —J A Hewitt Sarcocystis in Cardiac Muscle —B Sarkar

Tissues Stained by Iron and Tannic Acid —F W R Brambell and M Allanson Variation in the Number of Acidophil Cells in the Pars Anterior of the Pituitary of Adult Female Rabbits
NELSON TEXTILE SOCIETY (at Preston Technical School) —C A Harrington Designing of Fancy Fabrics

MONDAY, JANUARY 20

VICTORIA INSTITUTE (at Central Buildings Westminster), at 4 30 —Lt Col L M Davies Scientific Discoveries and their Bearing on the Biblical Account of the Noachian Deluge
ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge) at 5 —Lt Col R C F Schomberg Climatic Conditions in the Tarim Basin
INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (jointly with Liverpool Engineering Society) (at Liverpool University), at 7 —Discussion on Low Temperature Carbonisation of Fuel with Special Reference to its Combination with the Production of Electricity Introductory Papers by E H Smythe and E G Weeks (English Practice), and S McEwen (American Practice)
INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University) at 7 —T W Ross and H G Bell Recent Developments in the Protection of Three Phase Transmission Lines and Feeders
INSTITUTION OF MECHANICAL ENGINEERS (Graduates Section London), at 7 —O S Nock Modern Methods of Speeding up Railway Traffic
INSTITUTION OF AUTOMOBILE ENGINEERS (Glasgow Centre) (at Royal Technical College Glasgow) at 7 30 —Dr B P Haigh The Relative Safety of Mild and High Tensile Steels under Alternating and Pulsating Stresses
BRADFORD TEXTILE SOCIETY (at Midland Hotel Bradford) at 7 30 —D R H Williams Costing from a Manufacturer's Point of View
HUDDERSFIELD TEXTILE SOCIETY (at Huddersfield Technical College) at 7 30 —Dr S G Barker Recent Developments in Woollen Yarn Manufacture, including Carding and Spinning
ROYAL SOCIETY OF ARTS, at 8 —H J L Wright Three Master Etchers Rembrandt, Meryon, Whistler (Cantor Lectures) (1)

TUESDAY, JANUARY 21

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Dr F W Aston Isotopes (1)
ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5 15 —B Ellinger Japanese Competition in the Cotton Trade
SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Chamber of Commerce, Birmingham), at 6 30 —E J Dobbs Chrome Plating
LONDON NATURAL HISTORY SOCIETY (at Winchester House, E C), at 6 30 —W G Freeman Trinidad
INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub Centre) (at Loughborough College), at 6 45 —L C Grant The Breaking Performance of High Power Switchgear and of a New Form of Quenched Arc Switch
INSTITUTION OF ELECTRICAL ENGINEERS (North Western Centre) (at Engineers Club Manchester), at 7 —B A G Churcher and A J King The Analysis and Measurement of the Noise emitted by Machinery
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members and Graduates Section) (at Milton Hall, Manchester) at 7 —R Sutcliffe Air Conditioning for Cotton Mills
ILLUMINATING ENGINEERING SOCIETY (at Royal College of Music, South Kensington), at 7 —C H Ridge The Art of Stage Lighting
MANCHESTER ATHENÆUM TEXTILE SOCIETY (at Manchester Athenæum), at 7 —L G Larmuth Artificial Silk
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN at 7 —Capt G I Finch Mountain Shots in Kodacolor
INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Graduates Meeting) (at Broadgate Café, Coventry) at 7 15 —L Hathaway Preparation of an Engine for Production
INSTITUTION OF AUTOMOBILE ENGINEERS (at Engineering and Scientific Club, Wolverhampton), at 7 30 —T W Cooper Roller Bearings
INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Albert Hall Leeds) at 7 30 —Capt P P Eckersley Broadcasting by Electric Waves (Faraday Lecture)
SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street Sheffield) at 7 30 —G Stanfield Temperature Distribution and Stress Effects in Heating and Cooling of Masses
LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (at College of Technology Leicester), at 8 —M P Applebey Manufacture of Synthetic Nitrogen
ROYAL INSTITUTE OF BRITISH ARCHITECTS at 8 30 —Presidential Address to Students

WEDNESDAY, JANUARY 22

ROYAL SOCIETY OF MEDICINE (Comparative Medicine and Surgery Sections), at 5 —Discussion on Actinomycosis Common to Man and Animals
GEOLOGICAL SOCIETY OF LONDON at 5 30 —Prof J W Gregory, Dr Ethel Dobbie Currie, Dr J Weir Dr S Williams and Dr G W Tyrrell On the Geological Collection from the South Central Sahara made by Mr Francis Rodd —J V Harrison The Geology of some Salt-Plugs in Laristan (South Persia)
INSTITUTION OF AUTOMOBILE ENGINEERS (Manchester Centre) (at Engineers Club, Manchester) at 7 —H K Whitehorn Petrol Electric Vehicle Characteristics
NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Newcastle upon Tyne), at 7 15 —R Harding The Psychology of the Shipbuilding Industry
ROYAL SOCIETY OF ARTS, at 8 —G Stone Observations on the Mining Laws of the British Empire

THURSDAY, JANUARY 23

ROYAL SOCIETY, at 4 30 —Lord Rayleigh Normal Atmospheric Dispersion as the Cause of the 'Green Flash' at Sunset, with Illustrative Experiments —Dr F W Aston The Photometry of Mass Spectra and the Atomic Weights of Krypton Xenon, and Mercury —Prof O W Richardson A New Connexion between the Absorption Spectrum of Hydrogen and the Many Lined Spectrum —Dr P A M Dirac A Theory of Electrons and Protons —*To be read in title only* —R V Southwell and L Chitty On the Problem of Hydrodynamic Stability I —P J Daniell The Theory of Flame Motion —N K Adam and Dr O Rosenheim The Structure of Surface Films. Part XIII —F C Johansen Flow through Pipe Orifices at Low Reynolds Numbers —W B Pleass Some Physical Conditions Affecting the Setting of Gelatin and the Bearing of the Results on the Theory of Gel Formation —N F Mott The Collision between Two Atoms —C C Tanner and Prof I Masson The Pressure of Gaseous Mixtures III —F J W Roughton The Time Course of the Heat Effects in Rapid Chemical Changes Parts I and II —E T Hanson Diffraction —C E Marshall A New Method of Determining the Distribution Curve of Polydisperse Colloidal Systems Parts I and II —N K Adam Structure of Surface Films XIV —Prof E V Appleton Some Measurements of Equivalent Height of the Atmospheric Ionised Layer —T E Stein Some Remarks on the Conduction of Electricity in Metals and upon Allied Phenomena —A Harvey The Zeeman Effect in the Band Spectrum of Helium II —N F Mott The Wave Mechanics of a Ray Tracks
LINNEAN SOCIETY OF LONDON at 5
ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Prof H A Harris The Growth of Children in Health and Disease (1)
INSTITUTION OF ELECTRICAL ENGINEERS at 6 —L C Grant The Breaking Performance of High Power Switchgear and of a New Form of Quenched Arc Switch
ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts) at 6 30 —H B Howard Certificates of Airworthiness
INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College, Dublin), at 7 45 —Lt Col S E Monkhouse and L C Grant The Heating of Buildings Electrically by means of Thermal Storage
ROYAL SOCIETY OF MEDICINE (Urology Section) at 8 30 —A Clifford Morson The Pathology and Treatment of Carcinoma of the Penis
INSTITUTE OF RUBBER TECHNOLOGISTS (at Manchester Café Ltd, Manchester) —B D Porritt Some Aspects of Standardisation
INSTITUTION OF WELDING ENGINEERS (at Birmingham) —C A Hadley Modern Improvements in Resistance Welding Machines
ROYAL AERONAUTICAL SOCIETY (Yeovil Branch) (at Yeovil) —B L Martin Wapiti Steel Wing Construction

FRIDAY, JANUARY 24

PHYSICAL SOCIETY (at Imperial College of Science), at 5 —J M Nuttall and E J Williams A Method of Examining Stereoscopic Photographs —S E Green The Photography of Fabry and Perot Interferometer Fringes by the Use of a Simple Optical System —Miss W A Leyshon Characteristic of Discharge Tubes under 'Flashing' Conditions as Determined by the Use of a Cathode Ray Oscillograph —Demonstration by W E Doran of a pH Apparatus
INSTITUTION OF MECHANICAL ENGINEERS at 6 —E Watson Smyth General Operating Experiences with the first Wood Steam Generator
NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Newcastle upon Tyne) at 6 —R A MacGregor Failure of Steel Forgings and Castings through Fatigue
INSTITUTION OF CHEMICAL ENGINEERS (at Institution of Civil Engineers) at 6 30 —Dr H Levinstein Films and Fibres derived from Cellulose (Lecture)
JUNIOR INSTITUTION OF ENGINEERS, at 7 30 —W J Rees Refractories for Steam raising Furnaces
LEICESTER TEXTILE SOCIETY (at Victoria Hall Leicester) at 7 30 —F Willis Knitted Footwear
TEXTILE INSTITUTE (Lancashire Section) (at Harris Technical Institute, Preston), at 7 30 —J Starkie The Weaving of Artificial Silk
ROYAL SOCIETY OF MEDICINE (Epidemiology Section) at 8 —Dr G P Crowden Industrial Efficiency and Fatigue
ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Sir William Bragg Cellulose in the Light of the X Rays

SATURDAY, JANUARY 25

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —Prof R W Chambers Sir Thomas More and His Friends (1)
BRITISH ASSOCIATION OF MANAGERS OF TEXTILE WORKS (at Manchester Athenæum) at 6 30 —F H Smith Foreign Yarn Business

PUBLIC LECTURES

FRIDAY, JANUARY 17

UNIVERSITY COLLEGE, at 5 —G P Wells Comparative Physiology (Succeeding Lectures on Jan 24, 31, Feb 7, 14, 21 28, Mar 7, 14, and 21)

MONDAY, JANUARY 20

UNIVERSITY COLLEGE, at 5 —Prof A V Hill Oxygen and the Recovery Process in Muscle and Nerve (Succeeding Lectures on Jan 27, Feb 3 and 10)

TUESDAY JANUARY 21

KING'S COLLEGE, at 5 —Dr S Wright Physiology of Posture and Movement. (Succeeding Lectures on Jan 28 Feb 4 and 11)—At 5 30 —Dr C H Lobban Bridges and Bridge-Construction (Succeeding Lectures on Jan 28 and Feb 4)
UNIVERSITY COLLEGE at 5 —Prof S. Radhakrishnan An Idealist Philosophy of Life (Hibbert Lectures) (Succeeding Lectures on Jan 22, 28, and 29)—At 8 15 —Miss E Jeffries Davis How London became the Capital of England (Succeeding Lectures on Jan 28, Feb 4, 11, and 18.)

WEDNESDAY, JANUARY 22

UNIVERSITY COLLEGE, at 5 30 —J H Helweg Northern Mythology (Succeeding Lectures on Jan 29 and Feb 5

SATURDAY, JANUARY 25

HORNIMAN MUSEUM (Forest Hill), at 3.30 —H Harcourt Things Old and New from India's Treasury

SATURDAY, JANUARY 25, 1930

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Rationalisation

TO be reasonable may seem to the follower of custom to involve a disturbing rashness; and to be scientific may seem to imply an unnecessary exactness where 'hit or miss' has been the method used. Thus in Great Britain rationalisation may appear to be either revolutionary or too meticulous, although it is only the inevitable result of the advance in industrial methods which has occurred during the past twenty years. Words have a mythological power. In Germany 'pure reason' is admired; and the Germans seem to have invented the non-psychological industrial use of the word 'rationalisation'. In the United States, because there men revere 'science'—with little understanding of it—the phrase first used for the new policy was 'scientific management'. In general, as Mr. Urwick shows in his book, "The Meaning of Rationalisation," this name for an industrial policy implies the application of the exact methods of science to the organising of production. In its primitive form this policy involved only Taylor's plan for studying the movement of workers in machine production, for the purpose of eliminating unnecessary effort; but now the policy of rationalisation involves also (1) scientific research on materials, machinery, and sale methods, and (2) scientific or exact replanning of the managerial and financial organisation of an enterprise, leading in many cases to amalgamation of enterprises.

As an example of the need for reorganisation after a period of unorganised growth, mention may be made of a particular enterprise which has greatly expanded in the past twenty years. On investigation, the managing director of the firm in question found that his office was sending about 300 orders for stationery during the year to about 30 different firms. The incidental waste of energy and money affected the cost of production; but the system was the result of 'accretion' without design. Still more costly waste occurs in the iron and steel processes which some firms have inherited; and in methods of distribution the waste incidental to changes in the places where people live and changes in their habits are obvious in our streets. Of the need for thinking and for replanning traditional methods there is no doubt: the only common doubt appears to be how far we should carry our thinking.

Scientific research is clearly desirable, for the days of chance discovery of material or processes are probably over. But research on an adequate scale is too costly for small enterprises, and therefore

research is one of the reasons for more inclusive organisations The results of research on dyes have been discussed by Mr James Morton in his recent paper, read before the Royal Society of Arts, on "Fast Dyeing and Dyes" The Department of Scientific and Industrial Research provides some of the needs which are more generally supplied in Germany and the United States by large industrial organisations, independent of the State

Again, it is generally agreed that new machinery or new processes will reduce the cost of production, and rationalisation may therefore increase productivity, with less effort on the part of the worker and lower 'overhead charges' even when the new machinery is expensive In the Clyde engineering and shipbuilding trades, the same production as in 1914 can now be obtained with only about 60 per cent of the labour There was an indication of the new situation when an engine was placed in a ship in one afternoon, which it would have taken three weeks and perhaps six times the number of men to place in a ship in 1914 Similarly, in the United States "automatic electro-pneumatic systems of freight car control have eliminated switchmen Seven men used to operate trains in the New York subways now with automatic controls one motorman and one guard compose the crew The Boston and Maine railroad has a freight handling mechanism to take care of a million freight cars a year Switchmen and brakemen are eliminated One skilled man in a tower directs the process It saves the labour of four hundred workers" Such is the descriptive example given in Mr Stuart Chase's "Men and Machines"

From one point of view this process looks like an elimination of waste or of unnecessary effort and thus it is connected with the elimination of unremunerative plant, which, as the *Times* City notes on Dec 17 expressed it, has "become obsolete through the rapid march of science" The same notes continue "the bankers must bear some share of the responsibility for the slowness with which the principles of rationalisation have been practised"—they continue to give financial facilities to obsolete processes How many balance-sheets include values for assets that are really worthless? Thus rationalisation comes to mean 'facing facts' and eliminating waste plant and deleting mythical 'capital', as well as dismissing unnecessary labour

It is here that a new aspect of rationalisation appears, which is being studied by the International Industrial Relations Association, which exists for the promotion of satisfactory human relations in industry Passing beyond the old 'scientific management' into what is now known as 'industrial psychology', in the work of our own National Institute of Industrial Psychology, Miss Mary van Kleeck, of the Russell Sage Foundation, and other observers, have shown that more skilful management of men is essential to true rationalisation Heavy manual labour is being decreased and machine minding is becoming commoner, which may produce 'Robots' A new type of worker in industry is arising, and the old type of foreman and manager is already obsolete Again, the contraction of employment in the older processes is causing unemployment among the older men and women and the new processes are taking up the young Evidently new psychological problems are involved in rationalisation

In this connexion the establishment of the Institute of Industrial Administration is important [1] Evidently we cannot afford to trust to the appearance at the right moment of 'heaven sent' managers, for the management of men and the organisation of production require training, and we are now in the position of being able to use exact knowledge of methods In spite of differences in different trades and different traditions in different enterprises, there are some common factors in all industrial management Rationalisation implies the use in each enterprise of the knowledge of these common factors, but many employers and directors are still at the mental stage of those older teachers, who distrusted training for teachers on the ground that a teacher was born and not made The trouble is that an insufficient supply of 'natural' teachers is born and Nature supplies the art by which the deficiencies of Nature are amended So training and a test of competence are required for the supply of competent 'executives' in industry

There is, however, one of the most fundamental problems which the advocates of rationalisation and its practitioners are not considering The increase of productivity with less labour employed involves a decrease in the total of wages paid to the reduced number of workers, and wages are purchasing power Therefore the power to produce is increasing by methods which themselves decrease the power to consume If the same amount of production is obtained with only 60 per cent of the labour, then 40 per cent of the former number of workers have lost their power to purchase, and the unemployment benefit only just barely

[1] Registered Office 47 King William Street, London, E C 4

keeps their purchasing power at a minimum Now, most of the active business men who are rationalising are 'employers' or organisers of production, rather than commercial salesmen They tend, therefore, to aim in rationalisation at restricting the use of the new productive power to meet a shrinking market Profits are thus secured by preventing the use of productive power Not simply are 'less economic' enterprises closed down, but the whole of a great organisation may be used to cut production to the size of the market, and since less labour is needed every day, the market shrinks Unemployment is breeding unemployment

This is a problem of price rather than cost There is a need for house room and clothing which cannot become 'effective demand', to set the productive power going, because those in need have not purchasing power at the existing prices But there are ways of reducing prices, so that the gain from reduced costs may not all be pocketed by the producers, but may accrue to the final consumer It follows that for truly scientific consideration of the factors involved, we need a rationalisation of the market The use of credit, instalment buying, increased advertisement, and a changed education may be good or bad as means for reducing prices, but clearly some such means must be studied, if the rationalisation of the productive process is not to leave on our hands a problem greater than the problem it solves Traditional 'trial and error' in economic policy should give place to the scientific consideration of the market by an economic general staff

Rationalisation involves not merely greater efficiency of the labour used, and greater competence in management, but also large scale, long sighted economic policy Such policy must be based upon a scientific knowledge of the resources, natural and human, available for producing goods and services, a knowledge which the traditional 'business man' does not possess because he has confined his attention to his own enterprise The traditional economic science may also be proved to be inadequate for true rationalisation, since it rests upon a fatalism with regard to the market which is the result of a neglect to study 'consumption' Rationalisation in economic policy cannot omit to consider the needs which are not in fact 'effective demand', for there is no reason to suppose that a 'hidden hand' will provide a market if we think only of costs and not of prices, and there is every reason to believe that we can, if we give our minds to it, increase the market to meet increases of productive power

C Delisle Burns

Agricultural Science and Grassland

The World's Grasses their Differentiation, Distribution, Economics and Ecology By Prof J W Bews Pp xii + 408 (London, New York and Toronto Longmans, Green and Co Ltd, 1929) 21s net

RECENT years have witnessed quite a remarkable development in the application of science to questions associated with the utilisation and management of grassland The agricultural scientific workers of nearly all countries of the world appear to be devoting more and more attention to the manifold problems connected with grassland, and nowhere is this in greater evidence than in Britain and in the overseas territories of the British Empire So great is the volume of research now in progress relative to grassland, that it is no unusual thing to hear the view expressed that our workers in agricultural science are perhaps running the risk of neglecting the no less pressing problems of arable farming Apart altogether from the fact that there is an immense amount of leeway to be made up in connexion with the critical scientific study of grassland, and to the further fact that grassland contributes so materially to the agricultural wealth of nations, it should never be forgotten that pastures and meadows, and still more so temporary leys, have always taken, and are likely always to take, an important place in most schemes of husbandry largely based on the use of the plough Perhaps a truer criticism relative to the vast amount of research in progress is that it is being conducted from so many different angles, and without relation to any general philosophical attitude towards the grassland problem as a whole

The appearance of Prof J W Bews's important book on 'The World's Grasses" is, on this account, profoundly opportune—for in the last resort all studies of grassland must come back to the contributing species, and notwithstanding the fact that leguminous plants are of great importance, and although it is becoming to be realised to an ever increasing extent that numerous plants belonging to other natural orders are of decided significance, yet the fact remains that it is the order Gramineæ that sets the seal to the world's grasslands

The value of Prof Bews's book at the present juncture is that it at once rivets the attention of the student of grassland on species *qua* species—the bricks and mortar with which any proper appreciation of the grassland complex can alone be

built The merit of this arresting book lies in the fact that our author has not been content merely to describe the grass species of the world, and to prepare a very carefully planned key to the tribes and genera, but he has boldly assumed the rôle of systematist, ecologist, and physiologist, and has welded the immense amount of evidence brought forward into a definite thesis—a definite guiding principle—which is presented in the stimulating form of an endeavour to trace the phylogeny of the various genera and their evolution in relation to ecology

It follows that Prof Bews has written what is at once a book of reference and a highly suggestive treatise on the etiology of the world's grasslands The former aspect of the book is embodied in Chap iii with its key to the tribes and genera—a fine achievement this, to bring all the genera of so large an order into one key—and Chaps iv, v, and vi, which deal with the distribution, ecology, and economics of the genera

These chapters introduce no controversial subjects, and alone render the book one which should be available to all workers concerned with grassland For here is a remarkably trustworthy body of information collected in the compass of 167 pages (rather less than half the book) The nature of the treatment calls for generalisation, which must inevitably in certain particulars be somewhat indefinite, and perhaps more especially where particular species are concerned Thus, for example, it is stated that *Poa trivialis* is closely allied to *Poa pratensis* "and has the same habit", whereas the former species spreads by means of stolons and the latter by means of rhizomes An error, which from the context would seem to be quite accidental, occurs when it is said that *Bromus secalinus* is sometimes grown for hay The statement would be correct for *B arvensis*, which is mentioned in the preceding sentence

To attempt any detailed and unbiased criticism of the remaining—the challenging—chapters of the book is itself difficult, for specialists in different branches of botany are bound to hold their own views, and it would be almost unfair to the author, who advisedly has adopted the synthetic treatment and lays no claim to being a specialist in all the subjects necessarily brought under discussion All will agree, however, that Prof Bews's unique knowledge of the Gramineæ as revealed on almost every page of the book, affords a complete justification for his manner of treatment—indeed he may almost be said to have placed himself under an obligation to take a philosophical view of his subject—and consequently the real achievement of these chapters turns on the fact that he has envisaged our grasses and grasslands from a fundamental and really scientific point of view

We cannot, however, resist the temptation to quarrel mildly with Prof Bews on certain points of detail, and the more readily since he almost invites us to do so The main argument adopted from a phylogenetic point of view appears to be that in general a reduction in the inflorescence or in any of its parts, or the hardening of the structures surrounding the paleæ, indicates an advance upon the primitive form, while the primitive habitat is taken to be moist (or even wet) and warm Advance, then, means the capacity to occupy the extremes of dry and cold habitats The chief drawback to the whole system is of course that it necessarily places great emphasis on floral similarity and dissimilarity, and perhaps does not lay sufficient stress on vegetative characters The system adopted is perfectly satisfactory for taxonomic purposes, in which connexion there can be little objection to genera as dissimilar as *Phleum* and *Agrostis*, which are alike in little else but the uni floral condition of the spikelet, both being placed in the Agrostideæ Similarly, on the basis of the organisation of the inflorescence, *Lolium* undoubtedly finds a fit place in the Hordeæ, and yet it might reasonably be argued that phylogenetically it comes much nearer the genus *Festuca* in the Festucineæ than to any member of the Hordeæ, on account of the fact that *Lolium perenne* has been successfully intercrossed with three species of *Festuca* These examples at least show the danger—and a danger which the author has himself emphasised—of forcing phylogenetic interpretation upon a system of classification based essentially upon floral characters, and the danger is perhaps the greater because in the main such a system has the undoubted appearance of being natural

In his wholly admirable discussion on wide grassland types in their ecological aspects, the author is undoubtedly faced with certain fundamental difficulties—difficulties which in some cases are hard to surmount, especially when it is attempted to correlate phylogeny (based on taxonomy) with ecological facts In our view, the author has somewhat added to his difficulties when, for example, discussing temperate and alpine 'meadows' and 'pastures', he attempts to regard these as separate entities We thus find such a plant as *Lolium perenne*, so characteristic of the best old British grasslands, excluded from 'meadows'—but these characteristic swards would seem inevitably to fall

into the 'meadow' category, particularly since *Cynosurus cristatus* is regarded as a constituent of meadow herbage If it is legitimate, and we think it is, to include *Lolium perenne* in the 'meadow' category together with *Phleum*, *Alopecurus*, and other species, it would then also be incumbent upon us to contradict the statement that "meadow grasses are also relatively primitive types"

In dealing with the vast and relatively lightly grazed areas of grassland, the biotic factor—man and his grazing animals—is often of relatively slight significance, but the author has shown how greatly these grasslands may be altered when this factor comes into play When dealing with temperate 'meadows' and 'pastures', and even with mountain and alpine grasslands, the author has perhaps not taken the biotic factor sufficiently seriously into consideration, for wherever grazing reaches any sort of intensity, wherever domesticated animals come upon the scene, the biotic factor undoubtedly ranks with the edaphic and climatic as of supreme importance

Festuca and *Poa*, "regarded as representing the most primitive of the ordinary grasses", yet have a very wide range in temperate regions The dominant place taken by *Poa pratensis* over considerable areas in North America (areas which by no means represent particularly primitive habitats), for example, is due wholly or in very large measure to the biotic factor

It is not easy to estimate the extent to which the human biotic factor has influenced mountain, and particularly alpine grassland, but the occurrence together of *Poa alpina* and *Phleum alpinum*—two species of very different taxonomic-phylogenetic position—under alpine conditions may perhaps be considered significant rather than merely interesting

These closing remarks have been made solely to indicate the magnitude of the task which the author had set himself For this very reason, because Prof Bews has written this book, all who are interested in the science of grasses and grassland are placed under a deep sense of obligation to him The illustrations (the subjects of which have been well chosen to show the range of differentiation exhibited by the tribes and genera), the bibliography (which is extensive and in the main complete, despite the rather unexpected omission of Sinclair's "Hortus Gramineus Woburnensis"), and the index (the chief references to the genera are shown in heavy type) are worthy of the book and of the author

Pliny as a Chemist

The Elder Pliny's Chapters on Chemical Subjects Part 1 Edited, with Translation and Notes, by Dr Kenneth C Bailey Pp 249 (London Edward Arnold and Co, 1929) 12*s* 6*d* net

IN the preface to this delightful and scholarly volume, Dr Bailey complains that recently published histories of chemistry usually fail to give fair consideration to the chemical knowledge of the Romans Admitted, however, that Roman chemistry does generally receive scant notice, the reason surely lies in the comparative lack of material rather than in any wilful neglect on the part of the historian Rome has, in short, left us no grand chemical generalisations or striking chemical discoveries An eminently practical people, the Romans were quick to perceive the value of applied science, and Roman artificers and engineers were unequalled in skill and ingenuity Yet when the historian of chemistry attempts to lay his finger on definite advances which the Romans made, he finds it an almost impossible task Perhaps here and there a recipe is given that cannot be paralleled in an earlier age here and there is a process which seems particularly appropriate to special circumstances, here and there an apparently new operation is described, but that is all Roman craftsmen for the most part merely applied old knowledge with new efficiency, and Roman thinkers were more attracted to the laws of the State than to the laws of Nature

To understand later developments, it is nevertheless important to be able to gauge accurately the scope and content of Roman empirical chemical knowledge, and for this purpose Pliny's "Natural History" is invaluable The most modern translation of the whole of this great work is that of Bostock and Riley, published in 1855 and now almost *introuvable* In the long interval that has elapsed, the advance of both chemistry and the history of chemistry has been extremely rapid, and, as Dr Bailey justly observes, the historian now has at his disposal weapons so much more powerful as to warrant a new translation We are fortunate in that Dr Bailey has himself undertaken the task of editing and translating the chemical sections, the difficulties of which are numerous and often very perplexing

Pliny, whose numerous public activities culminated in his appointment as Admiral of the Fleet, collected a vast amount of miscellaneous information, and as he was by no means deficient in the critical faculty, much of it is closely accurate

The chemical sections, scattered throughout the "Natural History", are consequently in general plain statements of fact, largely free from the superstitious embellishments so exasperating to the student of early chemistry It is true that the statements are often erroneous, but they are at least not deliberately mystificatory

Primitive chemical writings present two categories of difficulties first, the establishment of the text itself, and second, the interpretation of technical terms and obscure allusions in the text when established Dr Bailey has not shirked either variety, and where the problems with which he was confronted proved insoluble, he has not hesitated to admit failure, these cases are, however, few, and are usually of such a nature as to seem permanently incapable of solution

As interpreted by Dr Bailey, Pliny's chemical knowledge surprises us by its extent and more particularly by its accuracy in detail As an example of the latter, it may be noted that Pliny mentions that the colour of minium (mercuric sulphide) is changed by heating but is regained on cooling, that it is, however, completely destroyed if the minium is heated with lime, that minium is turned black by the action of light, and that mercury may be obtained from it either (*a*) by the action of heat, or (*b*) by triturating it with vinegar in a copper mortar with a copper pestle Dr Bailey, with admirable thoroughness, tested the second of these methods experimentally He finds that in the cold the reaction is very slow indeed, but that on heating it takes place readily enough, copper sulphide being formed, while the surface of the copper turnings becomes covered with a copper-mercury amalgam, from which the mercury may be driven off by heating

The sections on salt contain many interesting points Thus in Book xxxi para 67, Pliny states that four *sextarii* of water will dissolve one *sextarius* of salt and no more—one of the earliest estimates of solubility (though not a very accurate one) As to the celebrated *sal Hammoniacus*, Dr Bailey agrees with Beckmann, Stillman, and others in believing it to have been an impure variety of sodium chloride, he says that we have no proof that the name was used of ammonium chloride before the tenth century A D Among Arabian writers, ammonium chloride is generally called *nushadhir*, but this is not infrequently equated with *milh armaniyyu* or 'Armenian salt', between the latter and 'Hammoniacal salt' there is an obvious possibility of confusion

'Chrysocolla', which travelled via Islam to medieval Europe, where it emerged as *harsufle*, is identified as malachite or copper carbonate, which is known to have been prepared in the way described by Pliny The natural product, says Pliny, although harder than the artificial, can be dyed with the herb called *lutum* (*Reseda luteola*) Dr Bailey finds that this is indeed so, and that the dyed compound possesses a fine emerald green colour far superior to that of the original malachite Noteworthy is the name *uva* for natural chrysocolla, doubtless a reference to the botryoidal masses in which malachite often occurs

On gold, Pliny has a great deal to say, much of which is—as the modern abstractor would express it—'polemical' against Roman habits of luxury He mentions, however, that the best proof of the purity of gold is a high melting point (*quam difficillime accendi*), that nothing can be beaten into thinner leaves, that it will not rust, and that brine and vinegar have no effect upon it, but that it is less dense and less malleable than lead

The present volume, which forms the first part only (Books ii xxxiii), contains the Latin text and English translation on opposite pages, together with a short introduction, 86 pages of notes, and a useful index We trust that Dr Bailey will soon complete the task he has so successfully begun, for, in addition to the intrinsic interest of the subject, it is pleasant to meet again the 'portly and somewhat pompous' Pliny, who, though a bookworm and a pedant, came to an untimely end through his insatiable scientific curiosity

E J H

Cicadas

Insect Singers a Natural History of the Cicadas By Dr J G Myers Pp xix + 304 + 8 plates (London George Routledge and Sons, Ltd, 1929) 21*s* net

THIS work, notwithstanding its title, is not a popular book, but a serious scientific treatise on Cicadas Dr Myers seems to have read and digested practically everything written pertaining to these insects, besides carrying out a considerable amount of personal investigation of their structure and behaviour

References to Cicadas date far back into ancient mythology (tenth or eleventh century B C), and the two chapters on this subject form a scholarly dissertation The two succeeding chapters are devoted to external anatomy and internal anatomy respectively The much-debated subject of the

morphology of the head sclerites is not discussed, but the author adopts a reasonable interpretation of the parts concerned Dr Vogel's little known work, on the existence of chordotonal organs in the so called mirror of the tympanal organs, is dealt with in some detail It is of much importance, because it affords the only reasonable proof of the existence of any structures capable of sound reception among these highly 'musical' insects In dealing with evolutionary problems, the author concludes that the Cicadas are a very isolated group with no ancestors among any fossil forms yet discovered the earliest known fossil Cicada is from the lower Cretaceous, and there is a wide gap until the definitely modern types appear in the Oligocene amber beds

In the account dealing with life histories, the difficulties involved in recognising the nymphs of different species are stressed, but in so far as the New Zealand Cicadas are concerned, Dr Myers finds that they can all be separated by characters afforded by the fore femora We also observe that he dispels the deeply imbued idea that Cicadas pass through a quiescent pre imaginal instar the so called 'pupa' being nothing more than the nymph in its final instars

Passing over a number of sections dealing with distribution, relations with plants, insect and vertebrate enemies of Cicadas, etc, the concluding chapters are concerned with sensory perception and psychological problems Especial attention is given to the 'song' of these insects, and the author has carefully analysed the various notes of a number of species and expressed them in the form of graphic music The chief rôle of the song is, he believes, an assembling one, but he also concludes that it operates to arouse in one or both sexes the emotions necessary to consummate the sexual act At the end of the book there is an extensive bibliography, the bulk of which is partly owing to the inclusion of references to all the taxonomic papers wherein new species of these insects are described A combined author and subject index follows

As a whole the book is a very good one, it is crammed with information and with extracts from the publication of different authorities, but it is not exactly a readable volume, but rather one which will be resorted to for reference Most of the illustrations are line figures, somewhat heavily drawn, and lacking in finer detail They give the impression of being hurriedly executed, but they serve to explain the points intended

A D I

Our Bookshelf

Australian Nature Studies a Book of Reference for those interested in Nature Study By Dr J A Leach Second edition, revised and reset Pp vii + 525 (Melbourne and London Macmillan and Co, Ltd, 1929) 12s 6*d* net

THERE is in this book an abundance, indeed an excess, of material from which teachers, either in Great Britain or in Australia, can construct courses About one third of the volume is devoted to plant life, rather less than half to animal life while the remainder is concerned with studies of inanimate Nature, such as soil, wind, water, denudation, and physical geography An essay on Nature study in education, and a suggested course in the subject, form an appendix This last should be consulted at the outset by those proposing to adopt the book

Amid the many styles and modes of address employed by the author, whose death, we understand, has occurred since his book appeared, we are puzzled, in spite of the sub title, to know for what class of readers he intended his book Books of these dimensions and at this price are not for pupils of tender years Yet frequently the mode is on heuristic lines, questions and instructions being addressed direct to the pupil Elsewhere the address is to the teacher while repeatedly the dialogue style is adopted, an imaginary teacher Socratically leading an imaginary, gesticulating class Interspersed among these variations is the style usual in text books The effect of these changes is not pleasing, and wastage of space results Moreover, too much has been attempted, the lists of plants and animals are needlessly lengthy, while the brief notes on them are often of little value A careful study of fewer would have produced a more interesting and more educative work

The illustrations are numerous and helpful they need close attention, for much that in most books appears in the text is here condensed in them, but we have found no difficulty in grasping the significance of any one of them

Fables of the Veld By F Posselt Pp xi + 132 (London Oxford University Press, 1929) 6s net

MR POSSELT has collected these folk-tales among the natives of Southern Rhodesia—not from one, but from a number of tribes The tales are not grouped either under tribe or subject, but the tribal origin of each is given in the table of contents Happily, the author has made no attempt to 'improve' the material and has aimed at preserving the spirit of the original

The tales are distinctly readable apart from the many points of interest they present to the folklorist The hero of a considerable group is the hare, who displays the cunning of Br'er Rabbit, but, like that worthy, frequently overreaches himself The Tar Baby here appears as a tortoise who covers himself with bird lime in which the hare becomes entangled Other parallels with

Uncle Remus are numerous 'Throwing the bones', the ritual of the South African witch doctor, here takes the place of the 'Table be covered' formula in Grimm

Jute and Jute Spinning Part 1 *Production of Fibre, Cultivation, Batching, Preparing and Carding* By Thomas Woodhouse and Peter Kilgour Second edition Pp xx + 301 + 21 plates 20s net Part 2 *Drawing and Roving Frames* By Thomas Woodhouse and Peter Kilgour Pp xxiv + 350 + 19 plates (London Macmillan and Co, Ltd, 1929) 20s net

THESE two volumes form a very welcome addition to textile literature The authors have a thorough grasp of their subject and a sympathetic understanding of the needs of students As text-books, the student of jute spinning will find them most comprehensive Very few text books on textile subjects cover the ground so completely The practical man will also have a most reliable source of reference, as the various types of machines and workings have been described and discussed in detail The subject matter is well arranged and the wealth of detail is presented in a manner that makes the reading of it most interesting This latter is in itself no mean accomplishment The line drawings are very clear, and the value of the work has been enhanced by the inclusion of photographs that in many cases were taken in the mills Practically everything possible has been done to explain the principles underlying the various operations

In the main, Part 1 is the same as in the 1920 edition, but in order to bring the matter up to date, an appendix, wherein improvements and changes in 'batching' and 'carding' are recorded and discussed, has been added The chapter on motive power gives a reasoned summary of an important item in manufacture This will be greatly appreciated, as, generally speaking, such information is only obtained from a search through a number of books and, this search completed, the application to a particular trade or machine requires to be worked out

In Part 2 is described and discussed at considerable length a wide range of drawing and roving frames The comparison in the treatment of flax and jute fibres is most instructive

While the volumes are primarily intended for those in the jute trade, they will also be of much service to candidates for the diplomas of the Textile Institute and to many others The authors and publishers are to be congratulated on a most successful production We anticipate a wide circulation for the new edition

ANDREW R GEARY

Enzyme Actions and Properties By Ernst Waldschmidt-Leitz Translated and extended by Robert P Walton Pp xviii + 255 (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1929) 20s net

PROF WALDSCHMIDT LEITZ has given a condensed description of the most important principles of the chemistry of enzymes and of the characteristics of the more important members of the group In other words, the material available has been selected and the viewpoint adopted is that of the Willstätter school The translator has extended the original German text with the help of the author, so as to bring the volume up to date

An important aspect of the subject dealt with is that of the quantitative determination of activity by taking into consideration both the relative activity and the amount of material obtained, it has been possible to follow the enzyme through a series of purifications, with considerable success in the development of methods of preparation Somewhat less than half the text is devoted to the general properties of enzymes and their preparation the remainder considers the different ferments separately, the esterases, proteases, and peptidases, aminoacylases, carbohydrases, catalases, peroxydases, oxydases, and fermentation enzymes There are numerous references to the literature One point attracted our attention, the author is described on the cover as Waldschmidt, instead of Waldschmidt Leitz

This appears to be a very useful volume on the subject and should find a wide circle of readers, as enzyme activity plays a part in every field of biochemistry

The Zoological Section of the Nuzhatu l Qulūb of Hamdullāh al Mustaufi al Quazuīnī Edited, translated, and annotated by Lieut Col J Stephenson (Oriental Translation Fund, New Series, Vol 30) Pp xix + 100 + 126 (London Royal Asiatic Society, 1928) n p

THIS learned translation affords a vivid glimpse of the zoological knowledge current in Persia in the early half of the fourteenth century, and may be compared with the "Physiologus", so long the zoological text book of medieval Europe It discusses the appearance and properties of 228 different animals, and the accounts lean to the economic point of view, for the uses of animals and their parts in medicine and magic assume much greater importance than habits or structures Judging from the frequency with which certain diseases are mentioned in this primitive materia medica, Col Stephenson regards the following as among the commoner diseases of fourteenth century Persia cataract, corneal opacities, stone in the bladder, ringworm of the scalp, leprosy, quartan fever, tuberculous glands

Many of the animals described are figments of imagination, but with the substantial creatures all are grouped in a simple classification based upon habit and habitat There is very much of interest in these old descriptions we mention just two points It is strange that although 'domestic animals' include the cat and nine others, the dog is omitted, although subsequent references (p 34) show that it was used for several purposes, and there is a prophetic suggestion in the association of mosquitoes with malaria—"three mosquitoes given along with a quantity of gum for three days to one with quartan ague will take away the fever" (p 64)

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

The Identity of the Colloidal Particles in Soap Sols and Jellies

TEN years ago we found that two portions of the same solution of soap could be brought into the states of either sol or typically transparent jelly respectively at the same temperature, and that such significant properties as conductivity, lowering of vapour pressure, concentration of sodium ion as measured with the sodium amalgam electrode, etc, were identical in both these states Sol and jelly differed only in mechanical properties such as rigidity and elasticity We therefore drew the obvious conclusion that the rigid structure of the jelly must be built up by progressive linkings together of the particles which pre existed in the sol (*Trans Chem Soc , London*, **117**, 1506, 1920)

Recently this subject has received much attention and our conclusion has been called in question However, we submit that the essential point has been entirely overlooked The whole question is whether or not it is possible to prepare specimens of jelly in which the typical mechanical properties of jellies are manifested without altering any of the quantitatively measurable properties of the original sol If this can be done our conclusion appears to be inevitable No attempt to attain such good specimens is recorded as having been made by the other investigators K Krishnamurti, in a recent letter to NATURE (Nov 2, 1929, vol 124, p 690), contents himself by saying that light scattering capacity is even more significant than any property we measured and that his specimens differed distinctly in this respect Now it is perfectly easy, as we showed, to obtain a soap solution in almost any desired degree of whiteness and opacity through curding or crystallising out, that is, through formation of innumerable excessively fine fibres of soap crystals like cotton wool on a much finer scale Parallel with this increasing whiteness, intensity of scattering and opacity goes a falling off in conductivity, etc Analysis of the mother liquor from which the curd fibres are crystallising, naturally shows that it is becoming correspondingly depleted in soap It is obvious that a soap curd is wholly different from a sol or jelly, and that the crystals are forming through the destruction and disappearance of the colloid which existed in the sol or jelly

We now therefore put on record that we have prepared samples of the same solution of sodium oleate, some of which were fluid sols and others typical jellies, but the light scattering of which was identical within the experimental error of a fraction of a per cent

For the measurements, we employed a 0 5 *N* solution of pure sodium oleate (made from metallic sodium, conductivity water and purest oleic acid prepared according to Lapworth) The specimens were illuminated by an arc, and the scattered light viewed through a large Schmidt and Haenach photometer with special Lummer Brodhun prism The intensities were matched by altering the width of the slits which were operated by micrometer screws, graduated into 560 divisions Interchange of sol and jelly in front of the same slit led to identical readings, plus or minus the small experimental error indicated above, when matched against any constant standard For example, the maximum divergences between sol and jelly are represented by readings such as 312, 314, 312, 314, for sol, jelly, sol, jelly, respectively Occasional specimens gave readings differing in the opposite direction At 24° the jelly is soft and could be made to flow, at 10° the sol and jelly show much greater light scattering, but are still equal to each other The jelly may be cut into pieces with a knife, whilst the sol is quite fluid The hysteresis in the change of light scattering of a soap sol with changing temperature mentioned by Krishnamurti is also exhibited by all other properties of soap sols, as we have repeatedly pointed out The final values, however, are reproducible when sufficient time is allowed

L Arisz (*Koll Zeit*, **7**, 49, 1915) found that the light scattering of solutions of gelatine both in sols and jellies changes greatly with time, temperature, and concentration without any discontinuity in the region of gelation Gelation then appears as almost irrelevant to the changes taking place in the colloidal particles and merely makes use of those present at the time

Our original observations and conclusions therefore stand and are not invalidated, as claimed, for example, by Hatschek (*Koll Zeit*, **48**, 246, 1929) in his work on cloudy agar gels or by Zsigmondy and Theissen (*Z anorg und allge Chem*, **179**, 266, 1929) on partially curded soap gels We would of course agree with von Weimarn (see E Iwasi, *Koll Zeit*, **43**, 70, 1927) in principle, that if two colloidal particles join even at a molecular point their composition or hydration must be to that minute extent altered Nevertheless, the piling or the cementing of bricks to form a larger structure is like the loose junction of particles of a sol to produce a jelly The formation of curd from a jelly is as drastically different an operation as would be the dissolution of the bricks in hydrofluoric acid or the fusion of them into a single casting

M E LAING McBAIN
JAMES W McBAIN

Stanford University,
California,
Dec 18, 1929

The Classification of the Primates

I HAVE for some time been interested in the classification of the Primates, from the point of view of a student of geographical distribution, and have suspected that the differences between the Platyrrhines and Catarrhines are more fundamental than is generally supposed, and that their resemblances may be due to convergence

Prof Elliot Smith's new classification, in NATURE of Dec 7, appears to take little account of the differences between the Platyrrhines and Catarrhines, as he unites the monkeys of both groups to form a sub order Pithecoidea, and separates the apes and man from the Catarrhines as a sub order Anthropoidea The purpose of this letter is to show that there are at least good reasons for other views as to the classification of the Primates Prof Elliot Smith is, of course, perfectly well acquainted with the evidence I will cite, but interprets it differently

J Thornton Carter (*Proc Zool Soc*, 1922) has studied the microstructure of the enamel of the teeth of the Primates, and has found that there are two types of enamel pattern In the Mascarene Lemurs, the Eocene Lemuroids *Pelycodus* and *Notharctus*, and the Catarrhines, the enamel prisms have straight edges, and are separated by a slight amount of interstitial substance In the Asiatic and African Lemurs (Lorisoids), Tarsioids (*Tarsius* and the Eocene *Hemiacodon*), and Platyrrhines, the prisms have wavy edges and are separated by a considerable amount of interstitial substance Carter emphasises the constancy of

the enamel pattern in natural groups, he writes, "In the long and well authenticated series comprising the ancestry of the horse, the microstructure of the enamel does not change, in spite of the modification of the teeth—Fossil rodents from the Eocene exhibit a close similarity in enamel structure to recent forms, and where, as in *Chiromys*, a Lemur has evolved a rodent dentition, the structure of the enamel still retains its Lemurine characters" I quote these remarks of Carter in order to show that it is not unreasonable to regard the microstructure of the teeth as of primary importance in the classification of the Primates A classification based on enamel pattern is

A Prisms with straight edges *Lemuroidea, Catarrhina*

B Prisms with wavy edges *Lorisoidea, Tarsioidea, Platyrrhina*

It may be noted that Gregory's description of the Eocene *Notharctus* (*Mem Amer Mus*, **3**, 1920) leaves no doubt that it belongs to the same group (*Lemuroidea*) as the Mascarene Lemurs, with which it agrees in enamel pattern

As regards the groups with wavy enamel prisms, a memoir by Beattie (*Proc Zool Soc*, 1927) on the anatomy of *Hapale* is of interest as showing the close relationship between Tarsioids and Platyrrhines According to Beattie the similarity in structure of the skull of *Hapale* and *Tarsius*, particularly of the nasal region and the orbit, is so close, that when other similarities are considered, it is evident that these two animals are nearly related

The series *Lorisoidea Tarsioidea Platyrrhina* therefore offers no difficulties But it must be admitted that the Catarrhines are the most advanced group of the Primates, and that most of their characters may be interpreted as further developments of Platyrrhine structure Nevertheless, the microstructure of the teeth indicates their direct derivation from the Lemuroidea, which stand at the base of the Primate stem

The absence of monkeys from the Tertiary beds of North America has led some authorities to explain their present distribution by means of a Tertiary land connexion between Africa and South America This hypothetical connexion is unnecessary if the monkeys are diphyletic Tarsioids were present in North America in Eocene times they may have entered South America when the connexion with it was established at the end of the Oligocene, their earliest known Platyrrhine descendants are found in Miocene deposits Catarrhines were present in Africa in early Oligocene times, but are unknown in Eurasia before the Miocene Probably, like the Proboscidea, they originated in Africa during the Eocene, when that continent was isolated

C TATE REGAN
British Museum (Natural History),
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Jan 2

Evolution and Evidence

THE transfer of Down House to the British Association led me to place on record elsewhere a few memories intended to illustrate my father's character One recollection I refrained from adding, both because it related to science and because at the critical point in my story my memory becomes hazy Here it is, however, in case NATURE should care to publish it

On more than one occasion I remember my father either pointing out or alluding to a part of a meadow where year after year the vegetation was different from that found in the immediate vicinity This he did with the object of indicating that though each of these different vegetations was evidently better adapted than the other to its own locality, yet no explanation of this fact could be given, though all was taking place under our eyes Then, with more warmth than was usual with him, he would show how weak in the light of such observations were certain arguments often brought forward against his views But what were these arguments? It is here unfortunately that my memory becomes defective

All that I can do is to mention a few fallacious arguments which I *believe* are *illustrative* of what was in my father's mind when he spoke A wonderful record now exists of the stages in the evolution of the horse, and yet we cannot indicate in what way the later forms were better adapted to their surroundings than were the earlier ones Hence, so it is urged, this evolutionary movement cannot have been the result of improvements in adaptation due to natural selection But if we cannot point out the nature of many of those adaptations which we know to exist in the organisms that surround us, is it not futile to hope often to be able to recognise adaptations in the imperfect records of animals which existed millions of years ago in changing environments concerning which we are very ignorant?

Another example is the erroneous reasoning often met with in regard to orthogenesis We should expect to find that somewhat similar species would be somewhat similarly and continuously changed in the process of evolution in order to make them better and better adapted to their somewhat similar surroundings, and this explanation of the parallelism and continuity of direction of certain evolutionary changes which took place in the past is not proved to be false by the fact that in none of the organisms concerned can we demonstrate that an improvement in adaptation was really taking place Then again it has been asserted that no use can be assigned to certain first recognisable modifications in fossil remains, although they seem to have been the foundations on which were built certain evidently beneficial structures which appeared in subsequent ages But if we cannot indicate what are the relative advantages of the major differences between the plants inhabiting different parts of our meadows, why expect to be able to indicate the value of minor evolutionary changes which occurred in the remote past?

If at the risk of uttering biological platitudes I add a few more words, it is only in the hope that I may be putting into modern dress some thoughts the underlying basis of which I probably absorbed years ago at Down We may regard each individual organism as springing from a group of genes fortuitously selected, in accordance with certain rules, out of the limited number of different kinds of genes which are to be found at any one time in the species in question, whilst the germinal material as a whole had been acting as a store house for the small mutations which had taken place from time to time in the past Some individuals will be better and some worse adapted to their surroundings, and the superior will survive in a biological sense in greater number than the inferior When the next generation is being formed, the groups of genes thus selected will be to some extent dispersed throughout the whole interbreeding group in question But the greater the number in the species of those genes which together would make a favourable combination, the more often would these superior individuals appear as the result of the fortuitous reassembly of such groups of genes

If we take any two antagonistic qualities of the same individual, such as strength and agility, selection is always tending to produce the appearance of the best possible compromise between them, and this optimum compromise may vary in accordance with very small differences in surroundings Different

races will therefore begin to arise in different localities, for example, the weaker and more agile forms becoming more numerous where the nature of the country especially favours rapid movement. Or the same kind of differentiation of forms may take place in consequence of a different use of certain elements in the environment being made by different individuals. After this bifurcation had thus begun, other qualities would have to be differently modified so as to be brought into harmony with these changes, thus causing a further increase in differentiation; for example, in order to make the best adaptation, the weaker and swifter forms might be benefited by a change in some third quality different from that which would be beneficial to the stronger and slower types. When once bifurcation had begun, the paths along which the evolutionary changes in these local races was taking place might thus become slowly more and more divergent. We feel no jar at a railway junction, and yet we may before long be miles away from where we should have been if the points had been set differently. In somewhat the same way, the circumstances which millions of years ago turned the current of evolution in one direction rather than in another have, as a rule, left no relic by means of which they could now be recognised, even though we can clearly see the differences in the utility of many structures which afterwards came into existence.

To sum up, at Down I was led to believe that negative evidence, or rather the absence of positive evidence, can do but little towards condemning any evolutionary theory; whilst it is to positive evidence that we must look in order to decide whether in our existing state of knowledge natural selection is to be accepted as the most probable hypothesis in order, in the main, to account for such adaptations as are clearly recognisable in Nature.

LEONARD DARWIN

Cripps's Corner,
Forest Row,
Dec. 28, 1929.

Gaseous Combustion

SOME years ago we began to investigate certain aspects of gaseous combustion phenomena in closed vessel explosions and in gas engines with the aid of flame photography. Our experiments, however, appeared to lead to absurd conclusions when the flame photographs were interpreted in the light of the view that the emission of luminous radiation in gases results directly from chemical combination, and we have since been attempting to trace the origin of the luminous emission.

We are now clear that the intensity of the luminosity in an exploded gaseous mixture is wholly, or almost wholly, dependent upon its temperature (as inferred from its pressure), and that the amount of chemical combination taking place at any time has little effect, if any, upon the intensity of the emission at that time; indeed luminosity is manifest in our exploded gases at a time long after that at which combination (as inferred from the chemical analysis of rapidly cooled samples) has been completed, and if the gases in this state are adiabatically compressed they become brilliantly luminous again. Flame photographs, therefore, while they give invaluable information as to flame propagation in inflammable mixtures, yield no information as to the chemical state of the gases behind the flame front, but merely indicate their temperature.

The work of Pringsheim and others, however, has shown that the more permanent gases do not become self luminous when heated externally to temperatures at which luminosity is manifest in our exploded gases. We are thus led to infer that molecules after combination are in an abnormal condition and that in this condition the luminous vibrations of which they are capable are excited by much softer collisions than those necessary to excite the corresponding vibrations in normal molecules.

Such an inference would perhaps be easy to accept were it not for the fact that we have to postulate a very long life history for the abnormal molecules (when the combination takes place wholly in the gaseous phase). We have, for example, recently made an explosion experiment under conditions such that cooling after maximum pressure took place very slowly in which luminosity was estimated to last for at least 14 seconds after maximum pressure, and we have little doubt that this period could be considerably extended by arranging for still slower cooling.

That chemical combination in the gaseous phase results in the formation of long lived abnormal molecules seems to be supported by another series of experiments which we have made. In these experiments continuous records of the temperature of thin platinum rhodium wires immersed in the inflammable gases were taken during explosion and subsequent cooling and correlated with continuous records of pressure, from which, of course, the mean gas temperature could be estimated. We found that wherever the platinum wire was placed in the explosion vessel, and even when the most violent turbulence was arranged for in order to secure uniform temperature distribution in the exploded gases, the temperature of the wire was some hundreds of degrees (often 500° C. and more) above the gas temperature (as inferred from the pressure) both during explosion and for some seconds afterwards, and therefore long after all chemical combination had ceased. Similar experiments were made in a gas engine with like results. It seems possible to account for these results only by assuming that the molecules after combination hold an excess of internal energy which can be rapidly unloaded upon the surface of the hot platinum wire when they come in contact with it, and in view of the fact that the phenomenon may last for some seconds, it would appear that the molecules persist in this condition for some time when in the gaseous phase.

Reviewing our work as a whole, we think that the most probable explanation is to be found in the suggestion that combination results in the formation of molecules of carbon dioxide and water of abnormal *structure*, which may persist for some time when in the gaseous phase, but pass instantaneously into molecules of normal structure on coming into contact with a hot surface.

Briefly, our suggestion is that the overall process of combustion may be broadly analysed into two stages. The first (the combination stage) may be represented thus

$$\boxed{A} + \boxed{B} \longrightarrow \boxed{A}\,\boxed{B} + (H - x)$$

where H is the heat of combustion, and the second stage (which in the gaseous phase may take many seconds), thus

$$\boxed{A}\,\boxed{B} \longrightarrow \boxed{AB} + x$$

If A and B represent atomic nuclei and $\boxed{}$ an electron atmosphere, $\boxed{A}\,\boxed{B}$ gives an indication of a possible type of abnormal structure and $\boxed{AB}$ that of the normal structure. For $\boxed{A}\,\boxed{B}$ it will be remembered we have to postulate a considerable stability in the gaseous phase, but it may be that the stability is apparent rather than real, and that the apparent stability is due to continual dissociation and recombination brought about by collision or to continual interchange of partners with neighbouring molecules.

The platinum wire experiments suggest that x may be an appreciable fraction of H, and we hope presently to test this by calorimetric methods both in closed vessel explosions and in a gas engine

An account of our experimental work has been prepared and will be published shortly

It is of interest to note that our platinum wire experiments suggest that the temperature (translational energy) of a Bunsen flame may be considerably less than 1800° C, which is the usually accepted figure

W T DAVID
W DAVIES

Engineering Department,
The University, Leeds,
Dec 19, 1929

The Mechanism of Electrolytic Rectification

UP to the present, the two most acceptable hypotheses which have been advanced to account for the electronic valve action of electrolytic rectifiers are (1) the hypothesis of Burgess and Hambuechen, and (2) that of Gunther Schulze The first accounts for the high anodic resistance, and the consequent rectification of alternating currents by assuming the formation on the anodes of an oxide hydroxide film pierced with small holes or pores which grow smaller when the electrode functions as the anode, and larger when it functions as the cathode, thus providing a variation in electrical conductivity correlated with the direction of the current The second hypothesis, commonly known as the gas-layer hypothesis, assumes the formation of a porous oxide hydroxide film on the surface of the active electrode, in the pores of which oxygen gas is occluded While functioning as the cathode, the electrons are freely discharged from the metal through the gas layer, whereas, since electrolytes contain no free electrons, current can only pass in the opposite direction by forcing the anions through the gas layer that they may liberate their charges to the metal—an action which demands the expenditure of very considerable energy

During intensive work over the past four years in a successful attempt to make available the important electronic valve action of aluminium and some of its alloys, freed from the former defects which, hitherto, have made it of little practical value, the mechanism of electrolytic rectification has been studied microscopically, and from these studies it appears that neither of the current hypotheses of electrolytic rectification are quite correct

The chief trouble with the aluminium rectifier, both in action and while under observational investigation, has been the use of electrolytes which on electrolytic dissociation liberate ions that readily attack and combine with the electrode metals

By using a special electrolyte which exhibits electrolytic reversibility with anodes of aluminium or aluminium alloys and cathodes of 'passive' steel (the subject of Patent No 284039 and others pending) it has been found that the internal resistance, together with the chemical stability of the cell, remains constant, and that the oxide hydroxide layer on the aluminium does not, to any appreciable extent, increase in density during action

Under these conditions the surface of the anodes in action can be seen to acquire an exceedingly thin oxide hydroxide layer below which, here and there on the metal surface, small 'cushions' of gas are formed One side of the gas cushions is in contact with the metal surface while the other is in contact with the overlying layer When as the cathode, electrons pass from the metal into these gas cushions, they penetrate the gas, and piercing the oxide-hydroxide layer, in ionic linkage, pass as cations to the anode The resultant condition of the active electrode is that the metal surface is covered by the oxide hydroxide film which, at various situations, is pierced by small holes immediately over the small cushions of gas The minuteness of the holes, the surface tension and gravitational pressure of the electrolyte, retain the gas within their chambers, and the unidirectional conductivity of the gas operates between the metal surface and the electrolyte

Thus it would seem that the hypotheses of Burgess and Hambuechen, and of Gunther Schulze, are both partially correct, and that a combination of these two hypotheses is the true explanation Further proof of this has been found in studies of what occurs at the 'sparking voltage', for then the dancing scintillation denotes the disruption of the gas cushions, the renewed access of electrolyte to metal surface, the re formation of the rectifying gas points, and the sequence of subsequent disruption and re creation

MALCOLM E MACGREGOR

Greenbriar,
Cobham, Surrey

Globular Lightning

I HAVE recently had an opportunity of investigating what would appear to be a case of globular lightning, and as this phenomenon is relatively rare, it seems of sufficient interest to record

In the afternoon of a day early last December, when there was a severe lightning storm in Liverpool, Mr Holder and his sister were sitting in the morning room of their house Browside, Mossley Hill, just

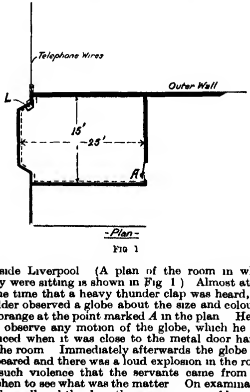

FIG 1

outside Liverpool (A plan of the room in which they were sitting is shown in Fig 1) Almost at the same time that a heavy thunder clap was heard, Mr Holder observed a globe about the size and colour of an orange at the point marked A in the plan He did not observe any motion of the globe, which he first noticed when it was close to the metal door handle of the room Immediately afterwards the globe disappeared and there was a loud explosion in the room, of such violence that the servants came from the kitchen to see what was the matter On examination of the wall and the door there was no sign of burning, but there was a strong smell similar to that which is commonly observed near Wimshurst machines or with ozonair apparatus The phenomenon is similar in character to those described by Dr Russell in his

presidential address to the Institution of Electrical Engineers in 1924, and by Dr Simpson in his review of Dr Walther Brand's book on ball lightning (NATURE, vol 113, 1924, pp 677 678)

It is difficult to suggest a satisfactory explanation of this phenomenon The only one that has occurred to me is that the lightning discharge induced a high frequency current in the telephone wires which were carried from the side of the house to a pole about 50 or 60 yards distant, and that this high-frequency current produced something like standing waves in the telephone lead (shown as a dotted line in Fig 1) If an antinode of pressure was formed at the point A, something analogous to globular lightning might have been produced at this point and thus have given rise to the phenomena observed

The windows of the house were not open at the time and it is therefore evident that the discharge must, in some way, have been produced inside the room Its general character corresponds fairly closely with the descriptions of globular lightning given by Dr Russell and others, namely, "a sphere of incandescent gas of a dull reddish colour"

F W MARCHANT

Laboratories of Applied Electricity,
The University, Liverpool,
Jan 3

Periodicity of Leaf-fall in Singapore

DURING the last two years I have kept regular observations, in the Singapore Botanic Gardens, of the behaviour of individual trees of species which show a marked periodicity of leaf development and leaf fall I hope to publish a full report after three years, but a brief account of the results already obtained may be of interest

Some of the trees are species of wide distribution, or exotic species, which in climates with a regular annual dry season have a leaf period of twelve months Most of these species in Singapore have periods of less than a year For example, the following are the approximate dates on which a tree of *Adenanthera pavonina* (Leguminosæ) has begun to produce new leaves, after brief leafless periods

	27 8 1927	22 3 28	21 10 28	28 4 29
Intervals	6 8 months	7 months	6 2 months	

The tree is now (Nov 1929) losing its leaves again This species is recorded by Wright as being annual in its behaviour in four successive years at Peradeniya, Ceylon, its new leaves developing there between November and January The tree in Singapore has flowered freely with every new crop of leaves, and has borne a full crop of ripe fruit before leaf fall

I have records of the behaviour of trees of a number of different species, and in some cases of more than one individual of a species The majority of the trees keep to fairly constant periods of their own, and trees of the same species often synchronise in their periods, but not always, where they differ in times of leaf-fall, trees of the same species usually have periods of approximately the same length Some individuals, however, appear to differ constantly by a small amount in the length of their periods from others of the same species For example, of two trees of *Cratoxylon formosum* (Guttiferæ), one has had periods of 9 3 and 9 2 months, the other of 8 5 and 8 3 months

In some species where the lengths of successive periods are very different, it appears that the occurrence or absence of flowering has a marked effect on the length of the periods In the cauliflorous *Ficus polysyce*, leaf period and fruit-period appear to be quite independent of each other Trees with a strictly annual period appear to be rare, either among native or introduced species Examples of annual behaviour are three very large trees of the family Leguminosæ, *Koompassia malaccensis*, *Parkia Roxburghii*, and *Hymenæa courbaril* Of these, the first named has produced new leaves in September in three successive years, and the other two in February Some Malayan species have periods of considerably more than a year

The regularity of period, usually not annual, is undoubtedly connected with the very uniform climate of Singapore, both as regards temperature and rainfall Though on the average the distribution of rain throughout the year is very uniform (there being no regular dry season), no two years are alike, I cannot, however, see any connexion between the leaf periods of any of the trees observed and the changes of rainfall

R E HOLTTUM

Botanic Gardens, Singapore,
Nov 24, 1929

A First Order Solid Phase Reaction

IN the course of an investigation on the kinetics of the thermal decomposition of ozone sensitised by the presence of bromine vapour, a very interesting reaction came to light Under certain conditions as to temperature and concentration of ozone and bromine (see *Z f anorg Chem*, 182, 182, 1929, *Z f Elektrochemie*, 35, 651, 1929), it was found that the bromine disappeared slowly but quantitatively from the gas phase and was deposited on the walls of the containing vessel as a solid oxide of bromine (*hitherto unknown*) Under these conditions of complete oxide formation, the residual ozone decomposed at a constant rate until nearly all of it had disappeared The final result can be represented as $2O_3 \rightarrow 3O_2$

The magnitude of the constant rate portion of the reaction was found to be directly proportional to the concentration of bromine originally present, that is $+\Delta p/\Delta t = k(Br_2)$, and therefore to the mass of bromine oxide crystals on the wall The concentration of bromine was varied a hundredfold (0 3 mm to 30 mm Hg) The rate is independent of the amount of surface, kind of material used for the reaction vessel, and oxygen, foreign gases, and ozone concentrations over a large range

It was shown that the ozone decomposition does not take place in the gas phase Nor can it be a surface reaction in view of the ineffectiveness of large increases in surface Furthermore, were the latter the case, one would have expected the rate to deviate from the above relation as the surface became saturated with oxide Even though exceedingly thick layers of oxide were deposited, the strict proportionality held

We have been led, therefore, to the conclusion that the reaction is of the first order and takes place in the solid phase of the crystals, that is, a definite fraction of the oxide decomposes per unit time *This appears to be the first known reaction of this kind* For a given amount of oxide the reaction appears to be zero order, because any oxide which has decomposed is immediately re formed by ozone, maintaining a sensibly constant amount of oxide

The presentation and discussion of the results of this work, which was done at the Physical Chemistry Institute of the University of Berlin, will appear shortly in the *Zeitschrift f Physik Chem*

BERNARD LEWIS

Bureau of Mines,
Pittsburgh, Pa

HANS JOACHIM SCHUMACHER

International Research Fellow,
Princeton University,
Nov 30, 1929

A New Relativity Theory of the Unified Physical Field.

I HAVE succeeded in applying to the above question what appears to be an important new conception regarding the significance of relativity mathematics with noteworthy results

I have abandoned altogether the quasi-geometrical interpretation with such hazy notions as parallel displacement in a curved space of *n* dimensions Instead, we construct an indeterminate vector field by means of Eddington's displacement rule, considered now as an association rule, and identify it at every point with the velocity a material particle might have if present there and then Vector lines in this field are necessarily the orbits of material particles under any physical conditions

We now construct an indeterminate tensor field, and by its means define the invariant magnitude of the elementary arc of these vector lines

Actual physical vector and tensor fields are necessarily determinate at every point, and these are defined as usual by applying the association rule round a closed loop This gives the usual symmetric and antisymmetric field tensors

When the antisymmetric field tensor vanishes the vector lines reduce to Einstein's so called geodesics The electric field is given by the antisymmetric tensor, and here the vector lines become mathematically equivalent to the known orbit equations Maxwell's first set of field laws are identically satisfied, and the set referring to electric charge and current are approximately true for small fields In strong fields in the neighbourhood of atomic nuclei the electron orbits reduce again to geodesics, independent of negligible radiation due to their acceleration, and Maxwell's second set of laws no longer hold This is obviously very strong support for our theory But further the introduction of field laws which reduce to Einstein's in the pure gravitation field appear to lead to a principle of selection among the orbits in nuclear regions

Before leaving England this summer I prepared a hurried account of the above theory intended for publication in the *Proceedings of the Royal Society* It unfortunately gave no explanation of the mathematics, which latter were faulty at one point A careful and complete revision has now proved the soundness of the theory, and publication will follow as quickly as possible WILLIAM BAND

Physics Department,
Yenching University,
Peking, Nov 26, 1929

Aucuba or Yellow Mosaic of the Tomato Plant Reaction of Infected Juice

IN the course of investigations into the physiology of virus diseases, it was observed that if the expressed juice from a tomato plant infected with aucuba mosaic disease be mixed with an aqueous colloidal solution of tomato chlorophyll, that is, the mixed green pigments extracted from fresh plant material by the method of Willstätter and Stoll from a healthy tomato plant, a marked action occurs under suitable conditions The most striking manifestation of this action is the development of a brown colour and, apparently, the destruction of a greater or lesser amount of the chlorophyll This browning action is either not shown or is shown to a very much smaller degree by the sap from a healthy plant

The reaction appears to show a marked sensitiveness to light and to be greatly accelerated by a light intensity of the order of 800 foot candles at a temperature of about 30° C, thus showing a certain parallel to the development of symptoms of mosaic disease in the living plant The reaction has not been found to occur to the same degree with a sample of infected sap which has been boiled for a few seconds, neither does it appear to be directly correlated with the oxidase or peroxidase content of the sap

Under the conditions of experiment, the browning has not been observed to take place to any marked degree with infected sap exposed to light in the absence of colloidal chlorophyll, although it is a matter of general observation that the sap from an infected plant either is brown or becomes brown on keeping Yet at the dilutions employed in the experiments referred to, this brown colour is scarcely perceptible and cannot account for the marked change on exposure to light, which is not shown by the sap in the absence of colloidal chlorophyll

These observations suggest that this reaction may provide a quick and quantitative means of studying *in vitro* the nature of the virus and its reactions, the examination of which up to the present has entailed prolonged inoculation experiments

Critical investigations are in hand with the view of obtaining a fuller understanding of this and cognate phenomena W F BEWLEY
BERNARD J BOLAS

Experimental and Research Station,
Cheshunt, Herts

The Vapour Density of Sodium

THERE is plenty of evidence in the literature to the effect that the vapour of sodium is monatomic Robitsch (*Ann Physik*, 38, 1027, 1912) determined the velocity of sound in the vapour at the boiling point and calculated the ratio of specific heats to be 1 68, and Taylor (*Phys Rev*, 28, 576, 1926) found no evidence of molecules at pressures of 10^{-8} mm Other evidence, which need not be considered here, tends to corroborate this opinion

With the discovery of the band spectra of diatomic molecules in the vapour of the alkali metals, it became necessary to consider the possibility of molecular association in the vapour state Carelli and Pringsheim (*Zeit f Physik*, 44, 643, 1927) calculated the heat of dissociation for the potassium molecule to be 0 61 volt A thermodynamic calculation indicates that potassium vapour will be associated to a very slight extent For sodium the best value of the heat of dissociation is that of Loomis (*Phys Rev*, 31, 323, 1928), $1\ 0 \pm 0\ 1$ volt, and thermodynamic calculations have been made which predict that there will be more molecules than atoms in the vapour of sodium near the boiling point Recently, Mr E G Walters, working with me in this laboratory, has re determined very carefully the vapour pressure and vapour density of sodium A complete account of the work will be published elsewhere, but it may be noted here that an apparent molecular weight of 25 was found for the saturated vapour at 706° C. By substituting the value of the equilibrium constant calculated from this result in the equation of Gibson and Heitler (*Zeit f Physik*, 49, 465, 1928) a value of about 0 75 volt is obtained for the heat of dissociation The agreement between this result and the value obtained by Loomis from band spectra cannot be considered entirely satisfactory without extending unduly the limits of probable error for one or both of the determinations

There is no reason to change the value for the entropy of monatomic sodium vapour calculated by Rodebush (*Proc Nat Acad*, 13, 185, 1927)
W H RODEBUSH

University of Illinois,
Nov 25, 1929

Native Policy in South Africa

I HAVE not read a full report of General Smuts's recent lecture at Oxford, but the note on p 816 of NATURE of Nov 23 suggests some questions

Is not the suggestion of segregation of the indigenous peoples of South Africa just about three hundred years too late ? The first colony of Europeans was established at the Cape of Good Hope in 1651 If the Africans were segregated, should they be denied the benefits of modern science, especially in health, hygiene, and transport ? In July there were articles in a Cape Town newspaper mentioning rates of infant mortality among the Africans, commonly 300 to 400 to the 1000 and rising in certain places to more than 500 to the 1000, while in the case of Europeans it was said to be less than 100 to the 1000 To this was attributed the stability of the ratio between Europeans and coloured in South Africa at the present time The full benefits of science can only follow the general spread of education

Is not the advantage of trying to maintain tribal distinctions a fallacy ? Have there not been discussions in favour of a United States of Europe ? How would tribal segregation have worked in Britain ? Think of the Scots pursuing their native customs north of the Tweed within a ringed fence, so to speak The breaking down of small tribal units and the synthesis now in progress must be beneficial in stemming strife and helping advancement This is occurring particularly under the influence of the great mining organisations, drawing labour from distant fields, and in turn calling on farmers for more food stuffs so that they also have to employ more labour

With the increasing ease of communication, which the African has been quick to adopt, the problem of the relations of the races must be solved on a basis much wider than that afforded by the limits of the Union of South Africa With this in view, the colonists in South Africa are no doubt already studying conditions in other parts of the Continent

G W GRABHAM

The Athenæum,
Pall Mall, S W , Dec 15, 1929

The Stern-Gerlach Experiment with Active Nitrogen

IN view of the frequent use of these columns for the discussion of the problem of active nitrogen, it may be of interest to record the following observation A stream of nitrogen, activated by means of a condensed electrical discharge, was submitted to analysis by the Stern Gerlach method The active nitrogen, after passing through the non homogeneous magnetic field, struck a screen coated with silver nitrate, producing a brownish black trace thereon To be able to interpret the trace, the apparatus was calibrated by running hydrogen through it, so obtaining the trace for atomic hydrogen, the splitting of which corresponds to mg = ± 1 The trace obtained with active nitrogen gave mg = ± $\frac{1}{3}$ This value is characteristic of the $^2P_{\frac{1}{2}}$ state of the atom This observation thus gives a partial confirmation of the most recent views as to the nature of active nitrogen Thus Kaplan and Cario (*Zeits f Phys* , 58, 769 , 1929) suppose that the after glow in nitrogen is produced by the interaction of a metastable nitrogen molecule in the $^5\Sigma$ state with metastable atoms in the ^2P and ^2D states The chemical activity is ascribed to the metastable atoms The presence of ^2P metastable atoms and the fact that they are chemically active is established by the above observation

It is, however, of considerable interest to note that though the exposures were continued up to as much as 40 hours, no evidence of anything but the $^2P_{\frac{1}{2}}$ state was obtained, although the $^2P_{\frac{3}{2}}$ state, in particular, would have been expected as well, since the whole $^2P_2$ level is presumably metastable and the separation $^2P_{\frac{3}{2}} - {}^2P_{\frac{1}{2}}$ is only about 1 cm $^{-1}$, according to Compton and Boyce (*Phys Rev* , 33, 145 , 1929)

Full details will be published elsewhere

L C JACKSON

H H Wills Physical Laboratory,
The University, Bristol

The Spectrum of Ionised Mercury Hydride

WHEN an arc discharge between mercury and tungsten electrodes in an atmosphere of hydrogen at 2 mm pressure takes place at such a low voltage (about 60 70 volts) that it cannot last more than a fraction of a second, the system of mercury hydride bands appears with remarkable intensity The set of bands occurring in the far ultra violet, which was first recorded by Jezewski (*Jour d Phys et le Radium*, Sept 1928), has now been found to be associated with ionised mercury hydride It can be definitely proved that it belongs to a $^1\Sigma \longrightarrow {}^1\Sigma$ system, the molecular constants being

	B_e	a	J_e	r_e	ω_e	x
Final state $^1\Sigma$	6 57	0 10	4 21 × 10 $^{-40}$	1 50 × 10 $^{-8}$	2016	0 020
Initial state $^1\Sigma$	5 8_8	0 3_8	4 7_0 × 10 $^{-40}$	1 6_0 × 10 $^{-8}$	164_7	0 04_9

Zero lines of the bands arranged in the n'/n'' table are

n' \ n''	1/2	3/2	5/2	7/2
1/2	44108	42168	40302	
3/2		43676	41810	40029
5/2				41398

Details will be given elsewhere

TAKEO HORI

Physical Laboratory,
Port Arthur College of Engineering,
South Manchuria

Width of Head and Pelvis in *Homo*

IN the *American Journal of Physical Anthropology*, April–June 1929, Prof John Cameron cites cranial measurements of numerous races, showing that the female skull is proportionately broader than that of the male The races measured are Bushman, Hottentot, various groups of negroes, Melanesian, Tasmanian, and Australian It occurred to me that the adaptive character of a broad pelvis might perhaps be correlated with an increased breadth of the head, the latter being then a secondary consequence of a sexual character of functional importance The breadth of the head (relative breadth) might again perhaps have other consequences

Prof Cameron writes me that the idea had not occurred to him, and his present opinion is that we have to do with a coincidence Yet the suggestion may be worth considering It would, of course, be very easy to obtain numerous head and pelvic measurements from living individuals, which would show any individual correlation that might exist

Possibly this whole matter has been discussed somewhere already Darwin remarks that some believe that the shape of the pelvis influences by pressure the shape of the head of the child

T D A COCKERELL

University of Colorado,
Boulder, Colorado, Dec 11, 1929

Weather Recurrences and Weather Cycles[1]

By Sir Richard Gregory

EVERY year the weather is in some sense abnormal, but the past twelve months have given us rather more than our fair share of extremes, beginning with the most severe winter since the famous frost of 1895, continuing through several long periods of drought to the rainiest November on record Unusual weather always leads to much discussion in the Press of the time honoured subject of weather cycles, and 1929 was no exception The point that the interval of thirty four years since 1895 was within a year of the famous Brückner cycle was not missed, and the spells of cool rainy weather which tempered the dryness of spring and summer have been widely hailed as manifestations of the ' Buchan cold spells '

Buchan, it may be recalled, was much interested in tracing annually recurrent spells of unexpected weather Thus a cold spell has been stated to occur regularly early in May, and has been associated with the so called ' ice saints ' Various explanations have been offered to account for this cold spell, the most popular being that in the course of the regular annual series of pressure changes which result from the increasing power of the sun in spring, an anticyclone develops over northern Europe at the time and causes a period of north easterly winds Another cold spell is supposed to occur in June, caused by the development of mon soon winds blowing into the interior of Europe Buchan in 1869 enumerated as many as nine such periods, to which he assigned the following dates

Cold Periods	*Warm Periods*
1 Feb 7–14	1 July 12–15
2 April 11–14	2 August 12–15
3 May 9–14	3 Dec 3–14
4 June 29–July 4	
5 Aug 6–11	
6 Nov 6–13	

These nine periods were deduced from observations in Scotland during a period of ten years in the middle of the nineteenth century In spite of this limitation, however, they have been assumed by many newspaper correspondents to be equally valid for the temperature of London in the twentieth century Such an assumption is quite unwarranted, and Buchan, if he were alive to day, would be the first to reject it No scientific evidence has ever been adduced that cold or warm periods have any tendency to occur in London on Buchan's dates

Alone among modern weather cycles, that of thirty-five years has a background of tradition, for it was described by Sir Francis Bacon before 1625 Many people are familiar with the passage from his essay " Of Vicissitudes of Things "

There is a toy, which I have heard, and I would not have it given over, but waited upon a little They say it is observed in the Low Countries (I know not in what part) that every five and thirty years the same kind and suit of years and weathers comes about again, as great frosts, great wet, great droughts, warm winters, summers with little heat, and the like, and they call it the prime , it is a thing I do the rather mention, because, computing backwards, I have found some concurrence

This weather cycle was rediscovered and carefully investigated by the late Dr Eduard Brückner, then professor of geography at the University of Bern, and it is now known generally as the Bruckner cycle His great work, " Klimaschwankungen seit 1700, nebst Bemerkungen uber die Klimaschwankungen der Diluvialzeit ", published in 1890, has become a classic for the patient collection and analysis of material from a great variety of sources He studied all the long records of rainfall, pressure, and temperature available at the time, and carried the record back into earlier centuries by utilising the variations of level in the Caspian Sea and other lakes in enclosed basins and in the great river systems of the world, the historic variations of ice conditions on the rivers of Europe, the dates of the wine harvest, and the frequency of severe winters

From all this material Bruckner deduced the existence of a long succession of cycles—series of generally warm and dry years alternating with series of generally cool and rainy years From A D 1020 to 1890 he found twenty five cycles, giving an average length of 34 8 years, but the individual cycles varied between twenty and fifty years With this in mind, we must not expect too much from the Bruckner cycle, for so great is this variation that only one cycle out of five comes within $2\frac{1}{2}$ years of the expected length When in addition one remembers that the amplitude of the variations is so small that in meteorological statistics the existence of the cycle can only be seen at all as the result of extensive smoothing, it becomes obvious that the Bruckner cycle is useless for the purpose of making long range forecasts of weather, and the interval of thirty four years between the cold winters of 1895 and 1929 takes its proper place as a mere coincidence

The true value of Brückner's work lies in a different direction Although the amount of rainfall may vary widely from one year to the next, the quantity of water which is stored up on the land areas, in the soil, in lakes, and in glaciers, varies far more slowly This stored water is not so closely related to the rainfall of the one preceding year as to the average rainfall of the ten preceding years, and if these ten years fall in the wet half of a Bruckner cycle, the quantity of stored water will be great Again, in the dull rainy countries of north west Europe, warm dry years are favourable for crops and vegetation, and on the whole the dry warm half of a Brückner cycle will yield better crops than the cool wet half, although there may be wide variations from one year to the next An agricultural community must take the bad years with the good, and trust to the surplus from a rich

[1] From the presidential address to the Royal Meteorological Society delivered on Jan 15

harvest to tide over a year of dearth, but at the end of the warm half of the cycle the community will be prosperous, while at the end of the cold half it will be poor. Hence waves of emigration and the movements of peoples are closely related to climatic cycles such as Bruckner's, which in this way may leave their mark on history. That, and not long range forecasting, is the rôle of the weather cycle.

In the rainfall of Great Britain the Bruckner cycle is far less important than one of fifty years. The authoritative pronouncement made by the Council of the Royal Meteorological Society in the matter of the supposed influence of broadcasting on weather contained a passage pointing out that groups of wet years in England have occurred about 1770, 1821 to 1830, 1871 to 1880 and 1922 to 1928, four recurrences at intervals of about fifty years, separated by groups of dry years in 1741–50, 1801–10, 1851–70 and 1891–1910, the inference being that the wet years since 1922 were due to some natural period of oscillation of the rainfall, and not at all to the relatively small electrical disturbance of the ether by human agencies.

Much attention has been given to the sunspot cycle in relation to weather, and the literature of this subject is enormous. Sunspots are a useful index of the activity of the sun, and they go through a not very regular cycle with an average length of 11·125 years. Taking account of the change of polarity discovered by Dr. G. E. Hale, it is more accurate to say that sunspots go through a double cycle of 22·25 years. In terrestrial phenomena, these changes of solar activity are accompanied or closely followed by fluctuations in the elements of terrestrial magnetism and by variations in the frequency of auroræ. In matters of weather, a connexion with temperature was first suspected by Riccioli so early as 1651, and was clearly demonstrated, for tropical regions, by W. Köppen in 1873. A fairly close relationship has been traced by Dr. C. E. P. Brooks between the sunspot number and the rainfall in certain parts of equatorial Africa, especially the plateau of Lake Victoria, and the eleven-year cycle in the level of this lake, which rises and falls with the rise and fall of solar activity. This is one of the most striking illustrations of the connexion between solar and terrestrial phenomena, as may be seen from the accompanying diagram (Fig. 1), reproduced from Dr. Brooks's memoir.[1] A similar relationship is found in Lake Albert and farther south in Lake Nyasa, though in the latter it is somewhat obscured by the large annual variation in the level of the lake and by other factors.

In Great Britain the eleven-year sunspot cycle, like the Brückner cycle, is of little importance.

Although we are undoubtedly governed in the long run by solar influences, these find their way from equatorial to temperate latitudes by many and sometimes devious routes, winds, ocean currents, and so forth, so that their unity becomes lost and they appear as an irregular series of changes following no apparent law. For example, it was found by Dr. G. Hellmann that the rainfall of Europe has two maxima and two minima in each sunspot period, and he explained this as due to the combination of two causes, the direct effect of the solar variations on the weather of Europe and the indirect effect due to changes at the equator extending their effect northwards. In 1928, Dr. Brooks, after an examination of the relation between sunspots and pressure, both at individual stations and the distribution of pressure as a whole, concluded "that at present the variations of sunspots in the eleven year cycle cannot be taken into account in predicting quarterly mean deviations of pressure in the eastern North Atlantic or western Europe".

Mean Monthly Readings of the Lake Gauge on Lake Victoria & Monthly Sunspot Numbers 1896 1927

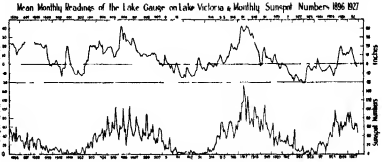

FIG. 1.

The suggestion has been made, notably by Defant, that there is a natural period of about 3½ years in the oscillation of the earth's atmosphere, which requires to be set going by some vigorous impulse; Defant found such an impulse in a violently explosive volcanic eruption. Others, notably Sir Norman and W. J. S. Lockyer, have found in them yet another manifestation of solar influence, such for example as is shown in the distribution of solar prominences. In some parts of the world, notably the East Indies, these periodicities of a few years are of undoubted value in forecasting the general rainfall some months ahead; in Great Britain they have at times reached a spectacular development, but always, just when they seemed to have established themselves thoroughly, they changed the length of their phase, or otherwise proved themselves unstable as water.

As the result of a great amount of research into a single definite problem, Mr. J. Baxendell was able to show in 1925 that we possess more exact information about a 5·1 year periodicity in British weather than about any similar phenomenon. The story of this period, as unfolded by the late Carle Salter and J. Glasspoole, begins in 1868. For fifteen years, up to 1882, each fifth year (1872, 1877, 1882) was very much wetter than any

[1] Air Ministry, Meteorological Office. *Geophysical Memoirs* No. 20 (London: H.M. Stationery Office, 1923.)

of the remaining twelve Then this series broke down, but from 1889 until 1909 there was a most remarkable sequence in which every third year was abnormally wet The years 1891, 1894, 1897, 1900, 1903, 1906, and 1909 were all wetter than the average, of the remaining eighteen, one was exactly normal and the others were all dry After 1909, however, the sequence changed to an almost equally remarkable two-year oscillation From 1910 until 1922 the even years were all much wetter than the average, while the odd years were all dry, with the sole exception of 1915, and even that year was drier than either 1914 or 1916 After 1922 this two-year sequence broke down, and now we seem to have returned temporarily to the three year type

Progress in Naval Engineering.

By Eng Capt EDGAR C SMITH, O B E, R N

THOUGH surpassed in length by the presidential address of Sir William White to the Institution of Civil Engineers in 1903, the Thomas Lowe Gray lecture delivered to the Institution of Mechanical Engineers on Jan 3 by Engr Vice-Admiral R W Skelton, Engineer-in Chief of the Fleet, on progress in marine engineering, bears comparison with it as an authoritative official review of an important subject While Sir William White traced the evolution of mercantile and naval vessels, Admiral Skelton confined himself to the progress in marine machinery, and his lecture is probably the most extensive survey so far written His predecessors, Admirals Durston, Oram, Goodwin, and Dixon, in their addresses and papers to the technical institutions, have all dealt with various aspects of naval and marine engineering, and were the series of contributions collected in a single volume it would go far towards filling one of the many gaps in the literature of engineering history Such a volume should at least be available in every man-of-war and every school where marine engineering is studied

Though not mentioned by Admiral Skelton, the first suggestion for a steam driven war vessel was made to the Admiralty by Earl Stanhope For him the authorities built the 'ambinavigator-ship', called the *Kent*, and so sure did Stanhope feel that he was on the high road to success that in June 1794 he signed a bond with a penalty of £9000 "to indemnify the public in case the said ship should not answer the purpose of Government" The inventor did not merely intend to produce a result, but he hoped "to establish every part of the subject on clear and irrefragable proofs, and to ascertain demonstratively what is the best possible plan" The experiments failed and the matter was dropped, without Stanhope, however, being kept to his bond Twenty years elapsed before the Navy had anything more to do with steam, and then the suggestion came from Sir Joseph Banks Capt Tuckey was preparing for surveying the river Congo in the *Congo* Why not fit her with a steam engine? Constructed by the greatest engineering firm in the world, Boulton and Watt, the engine was delivered, put into the ship, taken out again and set up in Chatham dockyard So heavy was the machinery that the *Congo* would have foundered in any sort of sea, and Capt Tuckey therefore wisely decided to stick to sails Five or six years passed and with the building of the *Comet*, *Lightning*, and other small steam craft began a series of revolutionary changes in everything pertaining to warships

It cannot be said that early naval requirements made any severe call on the engine constructors of the day Fulton had launched the *Clermont* in 1807, Bell the *Comet* in 1812, and steam vessels were proving their worth on every ocean But few realised the value of steam in war vessels, and there was no more stubborn opponent of steam than Capt Sir William Symonds, the Surveyor of the Navy The Russian War of the 'fifties, however, showed the futility of any longer trusting exclusively to the wind, and on April 22, 1854, the officers and men of the Black Sea fleet saw for the last time a British frigate in action under sail By that time, slow as progress had been, the paddle had given place to the screw, the flue boiler to the tubular boiler, engines were becoming more powerful, and many of the younger generation of naval officers, who knew more about railways and electric telegraphs than of the fighting of the Napoleonic wars, had eagerly taken up the study of engineering

Admiral Skelton gave much interesting information regarding those early days, and then proceeded to review matters which are more familiar to our ears He was unable to read the whole of the lecture, which, however, will be published in full by the Institution of Mechanical Engineers When available it will be seen to contain as an appendix a tabulated statement of some forty ships, from the fine paddle frigate *Terrible* of 1842 to the cruiser *Berwick* of 1925 It is a happily chosen list, and the progress of naval engineering could well be traced by a study of a ship from each decade The fourth ship in the list is the *Agamemnon* of 1851 Other wooden two deckers had been altered to receive the screw, but the *Agamemnon* was the first of her class to be designed as a screw ship Her engine by Penn would reflect credit on any shop to day It was a simple expansion horizontal engine with two cylinders fitted with trunk pistons something like the pistons found in a motor car The square tubular boilers generated steam at 20 lb pressure, and the engine developed 2268 h p The machinery weighed 320 lb per h p, cost £15 9*s* per h p, and consumed 5 lb of coal per h p per hour Compare this with the *Berwick*, the machinery of which, developing 80,000 h p, weighs only 45 5 lb per h p, cost but £5 6 per h p, and consumes only 0 89 lb of oil per h p per hour

Under the command of Capt W. R Mends the

Agamemnon was sent to the Mediterranean under sail, took part in the bombardment of Sevastopol in October 1854, and the following month successfully rode out the great storm which worked havoc in the fleet Mends, who had studied the steam engine, had an anxious time, but after the storm wrote to his wife "I soon had a third anchor down and kept the engine going to ease the cables, which, thanks to James Watt, enabled the good ship *Agamemnon* to ride easily"

The twenty pounds pressure of the *Agamemnon* represented the general practice at sea, marine engineers being timid regarding the use, and ignorant of the value, of high pressure steam A step forward was made in the *Constance* of 1860, which had John Elder's compound engines working with 30 lb pressure No one would want to be shipmates with her engines to day, for they were most difficult to handle and maintain Elder, however, was the leading advocate of the compound engine, around which a tremendous controversy raged, but which by the 'seventies was specified for all naval vessels The early twin screw ironclad *Dreadnought* of 1872, for example, had vertical compound engines of 8207 h p working at 60 lb pressure, and her coal consumption was but 2 32 lb as against the 5 lb of the *Agamemnon* of twenty years earlier It was about this time that engineers began to understand something of the work of Joule and his contemporaries on the mechanical equivalent of heat In the Royal School of Naval Architecture and Marine Engineering, too, naval engineers were trained under some of the finest teachers of the day, among whom was Prof Unwin, who is happily still with us, a veteran of more than ninety years

From the 'seventies onward change succeeded change The compound engine of Elder gave way to the triple expansion engine of Kirk, square boilers were replaced by cylindrical boilers, steam invaded every part of the warship, and the chief engineer of an ironclad became the head of a staff upon whose efforts mainly depended the efficiency of the ship as a fighting machine Nineteenth century mechanical engineering could show nothing finer than the great triple expansion reciprocating engines such as were found in the Atlantic liners, and in such cruisers as the *Drake* and *Good Hope*, each set of the engines of which developed 15,000 h p They were constructed when the demands of the naval authorities for greater speeds were incessant and when the attempts to comply with those demands brought a whole host of difficulties There were troubles with boilers, with condensers, with bearings, thrusts, pistons, pumps, auxiliaries, packings, pipes, joints, glands, and valves Engine designers did their utmost to overcome the defects, but it was, as Admiral Skelton said, upon the engineering branch of the Navy that the brunt of the work fell Yet it was also in the arduous times of the 'eighties and 'nineties that naval engineers gained the experience which proved of such vital importance to the Empire during the War

Of the forty-four ships in the Table, fifteen are turbine driven The list begins with the *Amethyst* and *Dreadnought*, and includes such well known vessels as the *Glasgow*, *Lion*, *Hood*, and *Nelson* No one is likely to disagree with the remark that the successful application of the steam turbine afloat was largely due to the soundness of the conceptions of the inventor and his thorough exploratory work in connexion with the marine application Had all innovations into the engine rooms of warships been accompanied by as few setbacks as was the turbine, naval engineering recollections would be far less interesting than they are The importance of the change from reciprocating engine to steam turbine is comparable with the importance of the change from paddle to screw, and so far as can be seen at present the turbine appears likely to hold its own for warship propulsion for a long time

The introduction of the water tube boiler came before the turbine, but the change from coal burning to oil burning has taken place in the last twenty years, and improvements in the stokehold have been as great as those in the engine room The results can be seen by comparing the *Dreadnought* of 1905, the *Hood* of 1916, and the *Berwick* of 1925 The weight of machinery per horse power, has diminished in the ratio 184 84 45 5, the square feet of floor space required per horse power in the ratio 0 45 0 136 0 118, while the cost of the machinery per horse power of the three ships was £13 9, £9 6, and £5 6 respectively There is necessarily an ultimate limit in the possible reduction in weight and size and fuel consumption, and some writers forty years ago thought they were within measurable distance of it, but the age of improvement is still with us and engineers are still striving, like Earl Stanhope, to determine "what is the best possible plan"

Obituary

MAJOR P G CRAIGIE, C B

MAJOR PATRICK GEORGE CRAIGIE, the leading authority for some half a century on agricultural statistics, died on Jan 10 at the age of eighty six years Educated at Perth, the University of Edinburgh, and St Catharine's College, Cambridge, he acted as secretary to the Local Taxation Committee from 1871 until 1890 and of the Central Chamber of Agriculture from 1879 until 1890 He was twice employed by Royal Commissions to report on the markets of Paris and Brussels, and on the agricultural schools of France Shortly thereafter, on the formation of the new Board of Agriculture, he was selected as the obvious man for the directorship of the Statistics, Intelligence, and Education Branch, a post which he held from 1890 until 1897, when he became Assistant Secretary, retiring in 1906 Craigie was the founder of modern British agricultural statistics, and their value is largely due to his enthusiasm and initiative

In spite of the heavy pressure of official duties, Craigie found time for much other work He became a fellow of the Royal Statistical Society in 1874, acted as one of the honorary secretaries from 1887 until 1902, and during 1902–4 occupied the presidential chair To the *Journal* of the Society he contributed a long series of papers, amongst others "The Cost of English Local Government", 1877, "Ten Years' Statistics of British Agriculture", 1880, "Statistics of Agricultural Production", 1883, "The Size and Distribution of Agricultural Holdings in England and Abroad", 1887, "The English Poor Rate, Some Recent Statistics of its Administration and Pressure", 1888, and his presidential addresses of 1902 and 1903

He was president of Section F (Economic Science and Statistics) of the British Association in 1900, and of the Sub-Section for Agriculture at the Winnipeg meeting of 1909 In the work of the International Statistical Institute he took a very active part, attending the meetings for many years as official British delegate, for a short period he was secretary-general and later treasurer The value of his services to statistical science, especially in relation to agricultural statistics, was recognised by the award to him, in 1908, of the Royal Statistical Society's Guy Medal in gold

A most kindly and genial man, "a redoubtable champion of agricultural interests, a pioneer of agricultural progress, a successful administrator during the seventeen years that he laboured at the Board of Agriculture, and probably the most loved of all officials who ever entered its portals", as Lord Bledisloe states in the *Times*, Major Craigie was greatly missed by many friends in London when, after his retirement, increasing years and infirmity kept him at his home in the west of England

HERR CARL SCHOCH

CARL SCHOCH died on Nov 19, 1929, at the age of fifty six years His death deprives astronomy of a very active student of ancient astronomical records, who has contributed to the improvement of chronology by the identification of several eclipses and other astronomical phenomena for example, his identification of the lunar eclipse observed at Ur in B C 2283 is used by Prof S Langdon in his recently published chronological tables His astronomical studies have been going on since 1900 He made a new determination of the *arcus visionis*, or distance from the sun at which different objects could be detected at their heliacal rising He also studied the rules that were followed in Babylonia, etc, as regards the insertion of intercalary months, a matter of great importance in the identification of recorded phenomena He worked for a time at Oxford, assisting Dr J K Fotheringham in the studies that he made, in conjunction with Prof Langdon, on the Venus tablets of Ammizaduga That work contains, as an appendix, tables of the moon and planets prepared by Schoch, which extend back to B C 3507 The secular accelerations play an important part in deducing positions at such remote dates Schoch made an independent study of these, reaching results nearly identical with those deduced by Dr Fotheringham In 1928 he published a revision of Oppolzer's 'Syzygientafeln', which greatly increased their accuracy Many of his astronomical conclusions have been referred to from time to time in our columns

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WE regret to announce the following deaths

Prof H L Callendar, F R S, professor of physics in the Imperial College of Science and Technology, on Jan 21, aged sixty six years

Prof Ludwig Claisen, of Kiel and Berlin, well known for his work in organic chemistry, on Jan 5, aged seventy eight years

Dr Harry Taylor Marshall, since 1908 Walter Reed professor of pathology and bacteriology in the University of Virginia, who was president in 1922 of the American Association of Pathology and Bacteriology, aged fifty four years

Mr F P Ramsey, lecturer in mathematics in the University of Cambridge, on Jan 19, aged twenty six years

Sir George Thane, professor of anatomy at University College, London, from 1877 until 1919, on Jan 14, aged seventy nine years

Dr Victor C Vaughan, formerly dean of the Medical School of the University of Michigan, member of the National Academy of Sciences and past president of the American Medical Association, known for his work on bacterial toxins, on Nov 21, aged seventy eight years

News and Views

CONGRATULATIONS from many in the world of science will be accorded in the coming week to Sir Robert Elliott Cooper, K C B, a past president of the Institution of Civil Engineers, and among the oldest of English engineers, who celebrates on Jan 29 his eighty fifth birthday, also to Dr Henry O Forbes, anthropologist, botanist, and pioneer traveller in many lands, who is seventy nine years of age on Jan 30 The former is a Yorkshireman, and he was educated at Leeds Grammar School Entering the firm of Messrs John Fraser, of Leeds, he left them in 1876 to engage in professional work in London, gaining a high reputation as a civil engineer Whilst president of the Institution of Civil Engineers, Sir Robert was responsible (1912) for an address which embodied a comprehensive and detailed survey of engineering projects completed or in hand in the overseas Dominions, Crown Colonies, and other parts of the British Empire Then, during the War, he was chairman of the War Office Committee of the Institution, perhaps the most signal as well as final expression of consistent and devoted public service We may add, however, to the record, his active interest in the advancement of the National Physical Laboratory There is a portrait of Sir Robert hanging in the apartments of the Institution of Civil Engineers

DR HENRY O FORBES was born at Aberdeen, and educated there at its Grammar School, graduating afterwards at the university, and at Edinburgh Exploratory work in little known regions of the world became a fascinating and compelling outlet for his activities, and this very early in life More than fifty years ago he was exploring and collecting in Java, Sumatra, and Timor The Royal Geographical Society allotted him the Gill Memorial Award in 1893 for explorations and observations in New Guinea, the Malay Archipelago, and Chatham Islands In 1890–93 he was director of the Canterbury Museum, New Zealand From 1894 to 1911 he was Director of Museums to the Corporation of Liverpool The British Association found a zealous coadjutor in Dr Forbes, whether as a member of council, lecturer, or in a consultative capacity Apart from book writing Dr Forbes is the author of various memoirs, detailed in the Royal Society's "Catalogue of Scientific Papers", among which is "New Guinea attempted Ascent of Mount Owen Stanley" The Government of Peru commissioned him in 1911–13 to report upon the birds of the Guano Islands Dr Forbes is an honorary LL D of Aberdeen

AT the annual general meeting of the Royal Meteorological Society on Jan 15, the Symons Memorial Medal for distinguished work in meteorology was presented to Dr G C Simpson Dr Simpson received his academic training at the University of Manchester, where he became interested in meteorology, and especially in atmospheric electricity A research studentship enabled him to carry out an investigation into the ionisation of the air in high latitudes, at Karasjok in Lapland On his return to England, he was for a short time attached to the Meteorological Office, after which he took up an appointment as reader in meteorology at his old university, where he conducted an important series of kite ascents at the University Observatory on Glossop Moor In 1906 he joined the Indian Meteorological Department, and in 1910–12 he was granted leave of absence to take part in Capt Scott's second South Polar Expedition His two volumes on "Meteorology", which form part of the results of that expedition, added greatly to our knowledge of the atmosphere in the Antarctic

AFTER a period of War service, in 1920 Dr Simpson was appointed a member of the Nile Irrigation Commission, and spent six months studying conditions in Egypt In September of that year he became Director of the British Meteorological Office Throughout his career he has maintained his interest in research, especially in atmospheric electricity, where his fundamental investigations into the origin of the electric charges in thunderstorms by the breaking of rain drops were followed by critical studies of the mechanism of thunderstorms and the nature of lightning In recent years he has become interested in the problems of radiation, and has shown how cycles of solar radiation are able to account in a remarkable way for the phenomena of the Quaternary Ice Age, including the succession of glacial and interglacial periods and the increased rainfall in unglaciated regions

REFERRING to our remarks last week (p 97) on Syon House and estate at Isleworth, where it is proposed to place a sewage disposal works, a correspondent reminds us that during the life of Sir Henry Percy, ninth Earl of Northumberland Syon House was frequently the home of some of the early English men of science Born in 1564, Earl Percy served in the Low Countries, fitted out a ship for fighting against the Spanish Armada and was a staunch supporter of the Stuarts Though a Protestant, he was, however, tried for treason after the Gunpowder Plot and spent many years in the Tower His love of astrology and scientific experiments caused him to be called 'The Wizard Earl" The English mathematician Nathaniel Torporley (1564–1632), the friend of Vieta, Thomas Allen (1542–1632), who wrote an exposition of the works of Ptolemy, and Thomas Harriot (1560–1621), "the universal philosopher", a correspondent of Kepler, and the first in England to observe sunspots, were all patronised by the Earl, and Harriot for many years lived in the old Syon House After the Earl had been committed to the Tower, Walter Warner, Thomas Hughes, and Harriot, like Raleigh, often kept him company there and were known as his "three magi" Torporley bequeathed to Syon House all his books, maps, and instruments

THE Institute of Industrial Administration, to which reference is made in our leading article this week, has laid down a definite course of instruction and established an examination for a diploma in industrial administration This is a step towards making industrial management a 'profession', and it should do something to mediate between the equally excusable but equally unsatisfactory opposite suppositions that educated men, on one hand, are incompetent in industry and, on the other, that the hand to mouth methods of the uneducated practical man are efficient Clearly, we can combine practical experience of the workshop with a wider knowledge of psychology, economics, and government than our old fashioned managers had A more fundamental issue, however, has still to be faced, if we are in earnest about rationalisation, for the directors themselves in certain enterprises seem to be incompetent It is not good sense, for example, to have as directors in a chemical trade men who know nothing at all of chemistry, or to have architects who know nothing about the chemistry of the new or the old building materials Even if shop organisers and employment managers are competent, they will be helpless so long as the directors in control of policy do not understand the *ABC* of the sciences which they might use The president of the Institute of Industrial Administration is Mr A S Comyns Carr, and its address 47 51 King William Street, London, E C 4

THE report of the twentieth meeting of the Indian Central Cotton Committee, held on Nov 11 last at the Institute of Plant Industry, Indore, contains several matters of scientific significance The interest taken by leading industrialists in India in the scientific development of agriculture is exemplary The work of the Institute of Plant Industry has impressed Indian industrial leaders and ministers so much that large

sums of money have been given to develop the new variety of Malvi cotton which the Institute has selected, and to put into practice the suggestions made by the Institute for the improvement of agriculture generally This interest may be illustrated by the following extract from the report of the speech of the Prime Minister of the Holkar Government at the meeting "We must naturally proceed slowly and only take up improvements and new ideas after they have been carefully considered and also carefully tested by scientific investigators whose experience, performance, and standing carry weight" This statement shows that the important part which science plays in industrial development is thoroughly understood by some Indian leaders

WE find later in the report that the Committee's plans are widening to include the cotton manufacturing industry A few years ago the Committee built the Cotton Technological Laboratory at Matunga, Bombay The laboratory has a large and capable scientific staff and is well equipped with modern apparatus and a complete spinning plant The standardisation of Indian cottons was its primary function, but its recent bulletins have included investigations in the technology of cotton spinning which are noteworthy contributions to this branch of applied science Again, Indian industrial interest has been stimulated by the work of a scientific laboratory with the result that it was decided at the Indore meeting to extend the work to meet the requirements of the mill industry and the cotton trade generally This step now brings within the control of the Indian Central Cotton Committee the scientific development of all branches of the Indian cotton industry, from the selection and raising of the crop to the production of the finished article The Committee is to be congratulated on its foresight, and all scientific men will appreciate its efforts to apply scientific control to the development of the Indian cotton industry

THE three leading events in the history of the steam railway were the opening of the Stockton and Darlington railway on Sept 27, 1825, the famous Rainhill locomotive trials of October 1829, and the inauguration of the Liverpool and Manchester Railway on Sept 15, 1830 If the first of these events showed the practicability of passenger transport by railway, the second demonstrated the superiority of the steam locomotive over all other methods of traction, while the world's railway system may be said to have had its birth with the completion of the Liverpool and Manchester Railway, when on Sept 15, 1830, a train composed of eight locomotives and twenty eight carriages, containing some six hundred persons, proceeded along the line The following day, Sept 16, regular trains were run, and by the end of the week there was a daily service of six trains in each direction To commemorate this epoch making event, arrangements are being made to hold a pageant and an exhibition at Liverpool on Sept 14–21 next, when it is hoped to bring together a collection of books, pictures, models, locomotives, etc, illustrating the progress of railroad transport An executive committee has been formed representing both civic and railway interests, with headquarters in the Royal Liver Buildings, Liverpool, and an appeal has been issued for information from anyone interested in the development of railways who can supply particulars of historic exhibits

IT is announced that the Latinisation of the Russian alphabet is a probable development of the near future A Moscow commission has studied the technical details and has almost completed its investigations Immediately after the Revolution, the Russian alphabet was simplified by discarding one or two superfluous or little used letters There are still more than thirty letters in the Cyrillic alphabet as against twenty six in the Latin, so that any change will necessitate either the elimination of further letters or, which is most likely, the introduction of diacritical marks to express sounds for which there is no precise equivalent among the simple Latin letters It will be recalled that some years ago Prof Bohuslav Brauner advocated this (the Czech) mode of transcription from Cyrillic to Latin in NATURE (April 29, 1922, vol 109, p 552) on the grounds of simplicity and faithfulness to the original The following changes involve the introduction of diacritical marks over consonants

ш becomes š pronounced as *sh* in she
щ ,, šč ,, *shch*
ч ,, č ,, *ch* in church

The letter ц, if transcribed to *c*, must be pronounced like *ts* in its The change from the Russian to the Latin alphabet is to be welcomed, for not only will it be easier for educated Russians to learn western European languages, but it will also facilitate the acquiring of a knowledge of Russian by others

THE fifth International Botanical Congress is to be held at Cambridge on Aug 16–23 next The sequence of congresses in this series is Paris 1900, Vienna 1905, Brussels 1910, the 1915 Congress was to have been held in London, and arrangements were well in hand when War broke out After active hostilities had ceased an international congress was formally discussed on several occasions, but it was considered that more would be lost than gained unless all nations could take part Eventually, American botanists offered to hold a congress at Ithaca in 1926 if British botanists would waive their title to precedence The conference was held as the International Congress of Plant Sciences (Fourth International Botanical Congress) The 1930 Congress returns to the old terminology

A PRELIMINARY programme of the Cambridge meeting has been circulated giving a summary of information for the benefit of foreign visitors and also the names of presidents, vice-presidents, recorders, secretaries, etc, of the Congress as well as of the eight sections bacteriology, phytogeography and ecology, genetics and cytology, morphology, mycology and plant pathology, plant physiology, palæobotany, taxonomy and nomenclature The programme gives expression to the general opinion that more benefit is likely to arise from discussions than from individual communications, and the sectional programmes give the titles of the proposed discussions, usually with a list

of those who have promised to speak Any person interested in botany may become a member of the Congress on payment of the subscription of £1, which should be sent to the honorary treasurer, Dr A B Rendle, British Museum (Natural History), S W 7, by April 1 next

IT is seldom that we refer to the weaknesses of popular natural history articles, but the *Nineteenth Century* for January published one on "The Badger and its Reputation", which moves us to protest In this ten page article, the first six pages, containing much general denunciation of the ignorance and inaccuracy of naturalists, scarcely mention the badger The remaining four, amongst otherwise simple information, state that "the badger appears to possess senses entirely unknown to science", that "unlike any other animal, he seems to be able to exist almost entirely without air", that the hedgehog, "another insectivorous creature", is in most of his ways a badger in miniature The Nature loving public deserves something better than this

INDEED, the same number of the *Nineteenth Century* includes another Nature article of very different stamp In "The Origin of Right", A Wyatt Tilby records the results of much observation and consideration of the curious fact that right sidedness is a widely spread feature in the animal world Right handedness is predominant amongst men, and more start off on the right foot than on the left Cats are said to be right footed, so are civets, genets, giraffes, and camels Even molluscs have usually right twisted shells On the other hand, wolves and deer are left footed, whereas dogs, horses, and antelopes start off indifferently with the right or left foot The author does not say under what conditions or from how many observations these results were obtained, but one of his conclusions is that practically every animal that grips, climbs, or hunts uses the right approach or the right foot first in preference to the left He also endeavours in a series of interesting paragraphs to trace the causes which may have contributed to the formation of the 'right' habit and its survival in different categories of animals Our impression is that the subject is still very hazy

IN an address in honour of Mr Edison at the dedication of the Edison Institute of Technology, the gift of Mr Ford, President Hoover paid a notable tribute to men of science and their work "Our scientists and inventors are amongst our most priceless national possessions There is no sum that the world could not afford to pay these men who have that originality of mind, that devotion and industry to carry scientific thought forward in steps and strides until it spreads to the comfort of every home, not by the profits of all the banks in the world can we measure the contribution which these men make to our progress And they are the least interested in the monetary results Their satisfactions are in their accomplishment—in the contribution of some atom of knowledge which will become part of the great mechanism of progress Their discoveries are not the material for headlines Their names are usually known but to a few But the nation owes them a great honour and is proud to demonstrate through Mr Edison to day that their efforts are not unappreciated The country can well pay its tribute to the men of this genius by expanding the facilities for their labours The nation to day needs more support for research It needs still more laboratories" The address, which was delivered at Dearborn, Michigan, on Oct 21 last, is a fine example of pointed eloquence It is published in the *Scientific Monthly* for December

LEONARDO DA VINCI, whether considered as artist, sculptor, architect, engineer, inventor, biologist, or physicist, is such an outstanding figure of his time, and the works he executed and the manuscripts he left are of such intrinsic value, that he is bound to attract the attention of succeeding generations of students His versatility was ably brought out by Mr E McCurdy, in his lecture to the Royal Institution, reported in NATURE, May 6 and 13, 1920 Dr I Hart has treated of his mechanical investigations, and a list of his contributions to pure and applied science is contained in Prof Usher's "History of Mechanical Inventions" It was G B Venturi (1746–1822) who first directed attention to the significance of Leonardo's scientific work, and much has been written since A further contribution to the study of his views is contained in the first number for 1930 of *Scientia*, in which R Marcolongo, of the University of Naples, deals with "The Dynamics of Leonardo da Vinci" The article is published in Italian After a brief review of the writings of the Greeks and of some little known work of the fourteenth century, the writer, using the manuscripts of Leonardo, quotes his statements regarding weight, force, gravity, the laws of motion, and motion down a plane and in the arc of a circle, showing him to be a precursor of Galileo and Newton Leonardo was essentially a reformer and belonged to that age which produced Erasmus, Copernicus, Durer, Luther, Agricola, and Paracelsus

RAPID progress is being made in constructing the Bavarian Zugspitze Mountain Railway, as it is desired to open service on this line, with the exception of the aerial ropeway to the top, before March This date was chosen so that visitors to the famous Passion play at Oberammergau may have an opportunity of seeing the beautiful mountain scenery traversed by the railway In many respects it will be like the Jungfrau railway According to *A E G Progress* for December last, the final station will be on the summit, 9750 feet above sea level The first section of the line, 4 7 miles in length, will be run by ordinary adhesion locomotives, the maximum gradient being only 3 5 per cent The next section, 6 9 miles long, will be a rack railway, and the final aerial ropeway to the summit will be 0 37 mile long The maximum gradient on the rack railway is 25 per cent, and on the aerial ropeway 68 per cent The Schneeferner Haus is a hotel at an altitude of 8750 feet, which has been planned by the railway company so as to provide plain accommodation for the ordinary traveller and luxurious rooms for the wealthy When the final section leading to the summit is com-

pleted next summer, the total time taken by the trains from the low-level station at Garmisch Partenkirchen (altitude 2300 feet) to the summit will be one hour and fifty minutes, three minutes only being required for the aerial ropeway The electric energy required for the railway is supplied by three phase current from the Isar power station At the sub station it is converted into direct current at 1500 volts by glass bulb rectifiers At full load these will work at 1650 volts These rectifiers are novel in design and are being used in practice for the first time

THE December number of the *Journal of Scientific Instruments* gives many illustrations of the uses to which science can be put by means of robust instruments which almost any one can safely use An apparatus is described by means of which the change in the moisture content of small quantities of a powder can be readily and accurately determined by means of a torsion balance Curves are shown and can be quickly found giving the rate at which moisture is absorbed by industrial products like flour, starch, and tobacco Results obtained in this way are of great use in commerce The General Electric Co describes apparatus which, when perfected, will measure the colour, temperature, and luminous output of an incandescent lamp Photoelectric cells are used, and it is satisfactory to find that definite results can be obtained An ingenious method of measuring the internal diameters of transparent tubes, perfected at the National Physical Laboratory, is described The two-ball method described enables the diameter to be easily measured in any given axial plane Thus the ellipticity as well as the variation in size of the cross section can be determined The method can also be applied to opaque tubes Steel balls the diameters of which increase by very small steps from 1/16 in to 1 in are readily obtainable The method can be applied to tubes the bore of which is only about three millimetres A description is given of an instrument for measuring the thickness of compressible solids, for example, fabrics, over a very wide range of pressures This instrument should be of use for the woollen and worsted industries The use of elinvar instead of steel in the spring of the Galitzin vertical seismograph at Kew has enabled the temperature coefficient of elinvar to be determined It is only one tenth that of the steel spring A clear description is given of the Moll recording microphotometer for use in the investigation of photographed spectra This journal contains much interesting information which should prove of value to all engaged in industrial research

AT the annual general meeting of the Royal Microscopical Society, which was held on Wednesday, Jan 15, the report of the council was adopted, and the following were elected officers and new members of council for the ensuing year —*President* Prof R Ruggles Gates, *Treasurer* Mr Cyril F Hill, *Secretaries* Mr J E Barnard and Dr Clarence Tierney, *New Members of Council* Prof W A F Balfour Browne, Mr E W Bowell and Prof Doris L Mackinnon, *Librarian* Dr Clarence Tierney, *Curator of Instruments* Mr W E Watson Baker, *Curator of Slides* Mr E J Sheppard The council's report stated that the Society continues to play an increasingly important part in the application of science to British industries In the absence of the president, Mr J E Barnard, through illness, the chairman announced that the presidential address on "Resolution and Visibility in Medical Microscopy" would be delivered at the Society's meeting in March A paper was read by Dr W E Cooke on asbestosis, in which he described the history and incidence of this disease amongst those engaged in the industry, and its identification A valuable contribution to our knowledge was also submitted by Mr T D Hamilton in a paper on "The Preparation of Thin Microscope Sections of Whole Organs by the Paraffin Method"

THE inaugural meeting of the eighty third session of the Pontifical Academy of Sciences, held at Rome on Dec 29 last, was honoured by the presence of His Holiness Pope Pius XI, who was received by the president, Prof P Giuseppe Gianfranceschi, the secretary, Prof Pietro De Sanctis, and the vice secretary, Prof Giuseppe Martinelli A number of papers were communicated, including the following A Belluigi rules for obtaining a good thermal yield with Schmidt magnetic variometers, P Luigioni second contribution to the knowledge of the entomological fauna of the National Park of Abruzzo a new species of Chrysochloa, A Anile new researches on the etiology of scarlatina, A Neviani lower marine organisms of supposed vegetable character, V Zanon diatoms of the Permian and Carboniferous, G Franchini experimental reproduction of leprosy in the ape, P Humbert Bessel functions of the third order, S Ranzi physiology of the embryo of cephalopods, Pasquini new experimental results on the grafting of the eye in Axolotl, C Gorini bacterial chymases, G De Angelis d'Ossat geology and the Roman catacombs One half of the prize of 10,000 lire offered for dissertations on the quantum theory has been awarded to Prof Wataghin, the other half being divided equally between Profs Straneo and Carrelli

THE ninety eighth annual meeting of the British Medical Association will be held at Winnipeg, under the presidency of Prof W Harvey Smith, professor of ophthalmology, Manitoba Medical College According to the provisional programme, the annual representative meeting of this year will be at the British Medical Association House, Tavistock Square, London, W C 1, on July 18–22 The statutory annual general meeting will be held in Winnipeg on Tuesday, Aug 26, and on the evening of the same day the incoming president, Prof W Harvey Smith, will deliver his address to the Association An exhibition of surgical appliances, foods, drugs, and books will be open during the Winnipeg meeting The presidents of the sections so far appointed are *Medicine* The Right Hon Lord Dawson of Penn, *Surgery* The Right Hon Lord Moynihan of Leeds, *Obstetrics and Gynæcology* Dr Comyns Berkeley, *Bacteriology, Pathology, Physiology, and Biochemistry* Prof Robert Muir, *Diseases of Children* Dr Robert

Hutchison, *Mental Diseases and Neurology* Sir E Farquhar Buzzard, *Ophthalmology* Mr N Bishop Harman, *Laryngology and Otology* Sir St Clair Thomson, *Preventive Medicine* Dr A S M Macgregor, *Tuberculosis* Prof S Lyle Cummins, *Radiology* Dr A E Barclay, *Medical Sociology and History of Medicine* Sir Humphry Rolleston, *Anæsthesia* Mr Raymond E Apperly The honorary local general secretary of the annual meeting is Dr J D Adamson 102 Medical Arts Building Winnipeg, Manitoba

PROF A C SEWARD, professor of botany in the University of Cambridge, and Prof V Grignard, professor of organic chemistry in the University of Lyons, have been elected associates of the Royal Academy of Sciences, Letters and Arts of Belgium

PROF THOMAS HUNT MORGAN, of the California Institute of Technology, who is widely known for his experimental work on the mechanism of inheritance, has been elected president of the American Association for the Advancement of Science and will preside at the 1930 meeting in Cleveland

DR J S PLASKETT, Director of the Dominion Astrophysical Observatory, who has been awarded the Gold Medal of the Royal Astronomical Society for his valuable observations of stellar radial velocities and the important conclusions derived from them, will deliver the George Darwin Lecture of the Society at the ordinary meeting on May 8

THE President and Council of the Royal Society have appointed Dr A S Parkes to the Foulerton Research Studentship, rendered vacant by the appointment of Dr R J Ludford to a senior post on the staff of the Imperial Cancer Research Fund Dr Parkes at present holds a Senior Beit Research Fellowship and is working in the Department of Physiology and Biochemistry at University College, London

THE following have been elected officers of the Royal Meteorological Society -*President* Mr R G K Lempfert *Treasurer* Mr Francis Druce *Secretaries* Dr C E P Brooks, Mr W M Witchell, Dr A Crichton Mitchell *Foreign Secretary* Mr C J P Cave *New Members of Council* Mr David Brunt, Prof Sydney Chapman, Dr Bernard A Keen

A CONFERENCE on grassland problems will be held at the Harper Adams Agricultural College, Newport, Salop, on Wednesday, Feb 5, commencing at 2 P M Addresses dealing with the formation, maintenance, and utilisation of temporary and permanent pastures will be given by Dr J A Hanley, principal of the Royal Agricultural College, Cirencester, Mr W B Mercer, principal of the Cheshire School of Agriculture, Reaseheath, and Mr R Boutflour, director of dairy husbandry at the Harper Adams College Each address will be followed by open discussion Arrangements are also in progress for an exhibit of implements especially designed for grassland work The Conference is intended primarily for farmers, but an open invitation to attend is given to all interested in the subject

AN account of the life and activities, literary and other, of Mr H G Wells is being written by Mr Geoffrey West As Mr Wells received his scientific training at the Royal College of Science, and has many friends in scientific circles, Mr West would much appreciate the assistance which any of them may care to afford in the way of reminiscences, impressions, or letters (or transcripts of letters), especially any referring to Mr Wells's earlier years or to specific activities Original letters (or transcripts to be returned) will be handled only by Mr West, and sent back without delay by registered post Matter may be sent direct to him at Acacia, Dane Bridge Lane, Much Hadham, Herts, or c/o Messrs Gerald Howe, Ltd, 23 Soho Square, London, W 1

AT the monthly general meeting of the Zoological Society of London, held on Jan 15, it was stated that the total number of visitors to the Society's Gardens during the past year was 2,047,090, the receipts amounting to £65,933, showing a decrease of £5723, as compared with 1928, and an increase of £86 as compared with the average for the corresponding period of the previous five years The number of visitors to the Aquarium during 1929 was 422,929, the receipts amounting to £15,657, showing a decrease of £1736, as compared with 1928

THE Diary for 1930 issued by the *Chemist and Druggist*, which has been sent to us, is a considerable volume, containing not only diary proper but also an extensive trade directory and a buyers guide a summary of the legal enactments which affect the pharmacist, formulæ of approved remedies and toilet accessories and much other useful information

A REVIEW of artificial light therapy, with records of its value in medical and surgical practice, compiled and edited by Dr R King Brown, has been issued by the Actinic Press (17 Featherstone Buildings, W C 1, 2s net) As reports have recently appeared casting some doubt on the value of artificial light treatment, this pamphlet will be of use as presenting evidence on the other side

FUR FARMING continues to gain adherents in Great Britain It was stated recently in the *British Fur Trade* that the number of silver fox farms in Great Britain had increased from 19 in 1928 to 32 in 1929, and the number of foxes from 500 to 801 In view of the wide interest in this new industry, attention may be directed to a leaflet, "Hygiene in Fox Farming", just issued by the Biological Survey Bureau of the U S Department of Agriculture No attempt is made in this 6 page leaflet to discuss diseases of foxes or their treatment, but directions are given for simple measures of hygiene and sanitation which may be employed with advantage by any fox farmer

MESSRS Bernard Quaritch, Ltd 11 Grafton Street, W 1, have just circulated a catalogue of their publications and of remainders Librarians and collectors should find it of service

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A second assistant pathologist at St Mary's Hospital W 2

—The Secretary, St Mary's Hospital, Paddington, W 2 (Jan 28) An assistant pathologist at Ancoats Hospital, Manchester—The Gen Supt and Secretary, Ancoats Hospital, Manchester (Jan 28) A demonstrator in pathology and bacteriology in the University of Leeds—The Registrar, The University, Leeds (Jan 31) A head of the Mechanical Engineering Department of the School of Engineering and Navigation, Poplar—The Education Officer (T 1), The County Hall, Westminster Bridge, S E 1 (Feb 1) A lecturer in biology at the Cheshire School of Agriculture—The Principal, Cheshire School of Agriculture, Reaseheath, Nantwich (Feb 8) A foreman recorder and demonstrator at the Denham Demonstration Station of the Middlesex Agricultural Committee—The Secretary, Education Offices, 10 Great George Street, S W 1 (Feb 8) A lecturer in physiology in the University of Stellenbosch—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W C 2 (Feb 15) A lecturer in entomology in the University of Sydney—The Agent General for New South Wales, Australia House, Strand, W C 2 (Feb 28) An assistant agricultural instructor in the department of the Federated Malay States — The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S W 1 (Mar 1) A professor of mathematics in the Queen's University of Belfast—The Secretary, Queen's University, Belfast (April 30) A junior physicist or engineer for research work on problems of heat conduction and insulation, a junior physicist or engineer for research work on aeronautics, a junior physicist for research work on electrostatics, a junior physicist for research work on X rays, a junior physicist for research work on photo electricity and television, a junior physicist for research work on ultrasonics, a junior physicist or physical chemist for research work on radioactivity, an assistant research physicist for work on electrical engineering, an assistant research physicist for work on aerodynamics and hydrodynamics, an assistant research physicist for work on mathematical physics, all at the National Research Laboratories of Canada—S P Eagleson, Secretary, National Research Council, Ottawa, Canada A junior pathologist and a junior soil chemist at the Rubber Research Institute of Malaya—The Secretary, London Advisory Committee, Rubber Research Institute of Malaya, 2 4 Idol Lane, Eastcheap, E C 3 A secretary of the Institution of Structural Engineers—The President, Institution of Structural Engineers, 10 Upper Belgrave Street, S W 1 A professor of zoology in the University College of North Wales, Bangor—The Registrar, University College of North Wales, Bangor

Our Astronomical Column

Wilk's Comet—Dr C H Smiley has deduced the following orbit of this comet from observations on Dec 21, 29, and Jan 5

$$\begin{array}{ll} T & 1930 \text{ Jan } 22\ 3005 \text{ U T} \\ \omega & 157^\circ\ 31'\ 1'' \\ \Omega & 179\quad 2\quad 27 \\ i & 124\quad 30\quad 10 \\ \log q & 9\ 827489 \end{array} \left.\begin{array}{l} \\ \\ \\ \end{array}\right\} 1930\ 0$$

Dr A C D Crommelin obtained the following observation on Jan 19, when the comet was bright enough to observe before the end of twilight

	R A 1930 0	S Decl 1930 0
Jan $19^d\ 18^h\ 6^m\ 3^s\ 7$	$21^h\ 41^m\ 48^s\ 03$	$1^\circ\ 9'\ 9''\ 7$

The comet was moving south and approaching the sun in Right Ascension It is not likely that further observations will be obtained in Europe, but Mr J P Moller has prepared an ephemeris for March and April for the use of southern observers (*I A U Circ*, No 244) Judging from its present brightness the comet should be followed at least until mid April, when it will be in Decl -49°, and distant from the sun 1 66 units

Changes in the Period of the Variable Star *R* Hydræ—*Astr Nach*, No 5669, contains an article by R Muller on the remarkable changes in the period of this variable As it occasionally reaches mag 3 5 at maximum according to Chandler, and is seldom fainter than mag 4 9 at that time, it is an easy object to the naked eye and records go back to the year 1662, H Ludendorff deduced from these that the period was then 486 days and that it increased to a maximum of 507 days about 1708, records are then scanty up to 1784, at which date the period was just under [illegible] days It then diminished rapidly and fairly uniformly, early in the present century it was little above 400 days According to Mr Muller, it has now begun to increase again He shows that Ludendorff's formula for the date 1915 needs considerable modification, he gives the formula for the dates of maximum $J\ D\ 2423040\ 0 + 411\ 7\ E + 0\ 8838\ E^2$, the first date is 1921, Dec 16 As no law has yet been determined for the changes of period, the terms depending on the square or higher powers of E are only provisional

Revision of Newcomb's Occultation Memoir—Newcomb was engaged for thirty years on this important memoir, which was finished during his last illness It discusses the occultations of stars by the moon observed between 1672 and 1908 The publication since then of Brown's Tables of the Moon enables the comparison between theory and observation to be made more rigorous This has been done by Dr H Spencer Jones in *Mon Not Roy Ast Soc* for November last Corrections of $-1\ 64''$, and $-1\ 78''$ (at the epoch 1800) are found for Brown's values of the moon's perigee and node The corrections to their centennial motions are much smaller than their probable errors Brown omitted Hansen's constant term of $-1\ 00''$ in the moon's latitude, but now admits that a term of about half that amount is required This is confirmed by the occultations

The discussion throws some light on the ellipticity of the earth The reciprocal of this is concluded to lie between 294 and 297 Newcomb's equinox is found to require a correction of $-0\ 71''$ at the epoch 1850, but the correction to its centennial motion is small and doubtful Eichelberger's larger correction of $-0\ 057^{sec}$ per century is concluded to be erroneous The solar parallax was determined from the parallactic inequality, using also recent occultations observed at the Cape, as $8\ 799''$ with a probable error of $0\ 003''$ A large diagram of the moon's errors in longitude shows that the occultations indicated smaller oscillations during the period 1750 to 1830 than those found from Greenwich meridian observations

Research Items

Bushman Craniology.—M. Eugène Pittard, following up his study of Hottentot and Griqua skulls, has contributed to *L'Anthropologie*, T. 39, No. 4, the results of the examination of a series of nineteen Bushman skulls from rock shelters, undoubtedly representing an ancient population. The measurements are studied in detail, but the general results may be summed up as follows. The mean cephalic index is 75·46 for males and 76·90 for females. These indices indicate sub-dolichocephaly. But among the females of the series are two, one sub-brachycephalic, the other brachycephalic, which cannot belong to the ethnic group. The males show no indication of brachycephaly, the highest male index (79·23) being masaticephalic, while the highest female (86·71) is hyperbrachycephalic. In height the majority of the crania are chamæcephalic, one female skull alone is hypsicephalic. The skulls are also mesognathous, one female being prognathous with a gnathic index of 106·59. The facial index, 47·34 male and 46·60 female, brings them within the chamæprosopic class, one female, however, being leptoprosopic. The orbital index is microseme, a few of the females being megaseme. The cranial capacity is 1476 c.c. for the males and 1357 c.c. for females. There are some interesting differences between the male and female skulls, apart from the naturally smaller absolute dimensions in the female. The female are less often dolichocephalic than the male and their mean index is higher. The occipital foramen, which is highly developed in both sexes, is larger in the female than the male, but the female index of prognathism is lower. The nasal index is higher in the female, being 59·35 as against the male index of 58·49. It is probable that the group upon which the study is based had not entirely preserved its primitive purity.

Danish-Carib Crosses.—A contribution to the study of racial crossing in man has been made by Mr. O. A. Merritt Hawkes (*Jour. of Heredity*, vol. 20, No. 10), who describes the descendants through four generations from a mating which took place about 1770 between a Frenchman in the West Indies and an Indian woman, probably a Carib. Their daughter married a blue-eyed Dane and had six children. Photographs of many of these individuals and their descendants are given. The Indian characters are regarded as dominant over European in F_1, but it is doubtful if this term is strictly applicable. The general points distinguishing the two races are given. An F_1 woman married to a Dane produced a boy and a girl of Danish type, fair skin with blue eyes, and three girls and a boy with dark hair and eyes and more or less Indian features. Hence this family showed segregation. Similarly, one of the dark daughters married to a blonde, blue-eyed Dane had five children, two Danish in type, one intermediate or mixed, and two remarkably Indian in appearance although reared in Copenhagen. The results in this and the fourth generation suggest a tendency to segregation of Danish and Carib types, or in other words, to linkage of the respective racial characters. But the appearance of mixed types as well indicates that such linkage is incomplete. That the son of a partly Carib woman and a Dane can be more Indian in 'type' than his mother is an interesting fact which requires further analysis.

Spread of the Mountain Hare.—The mountain hare or arctic hare is a native of Scotland north of the line of the Forth and Tay, but at various times about the middle of the nineteenth century it was set free in the southern uplands of that country. From two main centres of dispersal there it has succeeded in colonising the whole of the south country and has crossed the borders into Northumberland and Cumberland. From information furnished by the shepherds on the hill pastures Dr. James Ritchie (*Scot. Nat.*, p. 169, 1929) has traced the progress of the hare's movements, showing that less than half a century sufficed for the colonisation of this considerable area.

Behaviour of Starlings in Winter.—Starlings are well known to congregate in common roosting places in winter and the behaviour associated with their roosting habits has been the subject of an intensive and interesting study by V. C. Wynne-Edwards (*British Birds*, October and November 1929). The area investigated was in Devon and Cornwall, and in its 3000 square miles the starling population was estimated to be of the order of five millions. Winter roosts were ten in number, and the two most populous accommodated about 500,000 birds each, while in the others numbers ranged from about 50,000 to a quarter of a million. The flights of the birds to and from their feeding grounds were traced, and it was discovered that the feeding area of one of the largest roosts covered approximately 130,000 acres, and that while in general not more than five to fifteen miles were covered in the daily flight outwards, flights extended up to 24 miles. Apparently the flight stimulus is associated with the increasing intensity of light at dawn and its waning towards evening, for a table of observations shows a close correlation between the start of the first flight each day and sunrise. Roosting in winter is probably a much more common habit in birds than has been realised. In his own district, the author has traced twelve species of birds to roosts, some of considerable size, and he adds some interesting speculations on the advantage of the gregarious habit.

New Method of Treating Frequency Curves.—In a particularly arresting paper appearing in the *Journal of the International Council for the Exploration of the Sea*, vol. 4, No. 2, 1929, H. J. Buchanan-Wollaston and William C. Hodgson describe at some length a new method of treating frequency curves in fishery statistics. The method is based on three assumptions, quite new and fundamentally different from previously existing ideas on the treatment of statistical data, and producing fundamentally different results. Their applicability depends upon treating each sample of fish measurements separately, or on treating together only such data as are limited to a very restricted 'area' in time and space. It seems worth while to quote in full the authors' definitions of their three assumptions. They are: (1) that every frequency curve of fish measurements is compounded of several substantially different symmetrical curves of narrow range, similar to the curve of error; (2) that every maximum shown in the rough frequencies corresponds to a real mode; and (3) that the comparative rough frequencies given by the data, even if very small in number, correspond sufficiently well with the actual frequencies of fish at each length on the ground to be treated as absolutely correct, with an insignificant error. These assumptions, the authors wisely add, can be justified only by results. Some results of the application of the new method, particularly to herring data, are given.

***Terra Nova* Madreporaria.**—Prof. J. Stanley Gardiner records ten species of Madreporaria from the Antarctic (glacial) area of the Ross Sea and from the temperate

area north of New Zealand (Madreporaria (b) Turbinolidæ and Eupsammidæ, Cœlenterata Part 4, British Antarctic (*Terra Nova*) Expedition, Zoology, 5, No 4, 1910 Natural History Report, British Museum (Natural History), 1929) Of the Madreporarian corals obtained by the *Terra Nova* Expedition, those from the Atlantic Ocean and belonging to the genus *Favia* have already been reported on by Prof George Matthai (*Zoology*, 5, No 2, 1919) The present reports deals with the remainder, three out of the ten being new species The genus *Gardineria* of Vaughan is recognised, to which two of the new species belong, a possible third or even two more being mentioned Much of the text is taken up with a description of *Gardineria antarctica* n sp, which is figured in a good plate with *Gardineria lillei* n sp, also from the Antarctic, *Dendrophyllia japonica* Kent and *Flabellum harmeri* n sp, the last two from New Zealand Notes on collecting and preservation are a useful addition to this work The author prefers spirit for preserving corals If kept in the dark, the flesh alters little or not at all in thirty years

Arthropods as Intermediate Hosts of Helminthes — Maurice C Hall (*Smithsonian Misc Coll*, vol 81, No 15, 1929) has prepared a useful list of arthropods which have been shown to act as intermediate hosts of helminthes The list of arthropod hosts of cestodes is prefaced by the remark that the known number of such cases is so small that a comprehensive list can be given, but since the life histories of only about one per cent of the known species of tapeworms have been worked out, generalisations must be made with care Probably many cestodes now known as having only one intermediate host will be found to require two The list of cestodes and their intermediate hosts (10 pp), of trematodes (9 pp), of nematodes (15 pp), and of Acanthocephala (4 pp) is followed in each case by comments on the life histories of the different families The next part of the work consists of a table of arthropod hosts of helminthes arranged systematically—the orders of insects, the Arachnida, Myriapoda, and Crustacea There are altogether 143 species of helminthes parasitic in vertebrates which have arthropods as intermediate hosts and for which the primary hosts are known, there are also 61 larval forms for which the primary host is unknown The author pleads for better co operation between parasitologists and those who work on arthropods and suggests that the latter should direct the attention of parasitologists to any larval helminthes which they find during the dissection of insects

Peter I Island —This antarctic island, lying off the antarctic continent to the south of the Pacific, has seldom been sighted and never explored since Bellingshausen discovered it in 1821 In 1927 it was visited by the Norwegian whaler *Odd I*, and again in 1927 by the *Norvegia* An article on the explorations, with a map of the island, by Capt W Sachse, appears in *Petermanns Mitteilungen*, Hefte 11 and 12, 1929 The island appears to be entirely volcanic and fringed with steep cliffs It is almost entirely covered with ice even to the summit, which is at about four thousand feet The length of the island is about fifteen miles, and the breadth about seven miles The position of the centre is lat 68° 50′ S, long 90° 35′ W There is no harbour of any value, and landing is practically impossible

The Length of a Nautical Mile —The nautical mile being one minute of longitude varies in length from equator to poles The variations depend of course on the figure of the earth The accepted mean of 6076 8 feet is taken in practice as 6080 feet for navigational purposes This is 1853 2 metres At the International Hydrographic Congress held at Monaco in April 1929, it was decided to recommend that the nautical mile should have a length equal to 1852 times that of the standard metre This has an equivalent of 6076 0 feet In *La Géographie* for Sept-Oct 1929, M Vallaux gives some of the lengths now in use in various countries The figure of 1852 metres has been used in France since 1906, and also by Germany, Denmark, Iceland, Norway, Sweden, Greece, and Japan Belgium has a mile of 1854 metres, Italy and Spain 1854 8 metres, and the United States 1853 25 metres or 6080 2 feet

The 'Green Flash' at Sunset —A satisfactory account of the origin of the 'green flash' of the upper limb of the sun when it disappears at sunset is given by Lord Rayleigh in the January issue of the *Proceedings of the Royal Society* As he points out, the colour cannot be due to retinal fatigue, since it can also be seen at sunrise, and it has come to be generally recognised that it is due to the dispersion that accompanies atmospheric refraction, the green usually seen being more refrangible than the general light of the disc at the horizon The main point remaining to be decided was whether the normal dispersion of the atmosphere was sufficiently large to explain the effect, and Lord Rayleigh has now shown that it is in fact probably adequate, and has also been able to demonstrate a 'flash' in some neat laboratory experiments with a glass prism of small angle as the dispersing medium As possible causes of the natural 'flash' being green rather than the more refrangible blue, he mentions the inferior visual luminosity of the pure blue of the spectrum, and the relatively greater toll taken of the blue by atmospheric scattering Lord Rayleigh refers to Prof R W Wood's suggestion (NATURE, Mar 31, 1928, vol 121, p 501) that the flash is seen best when for some reason the atmospheric dispersion near the horizon is unusually large, and remarks that, if this is the case, sunset should be deferred upon such occasions by a time of the order of two minutes, a phenomenon for which he hopes to have search made in tropical seas

Protective Devices on Electric Supply Networks — The necessity of protecting the networks of cables and overhead wires which now link electric power stations with their consumers and with other power stations from accidental damage due to short circuits or lightning has led to an extensive use of protective devices of all kinds, the manufacture of which is an important industry In modern practice, networks, instead of receiving, as formerly, a supply from a single feeding point, receive it from many points As a result, when a 'fault' occurs, the direction of the current flow in a main depends upon the position of the fault in the network Those devices, therefore, which act when the current flow is in one direction only are no longer applicable The more elaborate protective devices being tried are naturally more expensive, but engineers regard this cost as the insurance premium for their mains On the Continent, the neutral point of a network of overhead power lines is generally insulated from the earth If a fault develop on one of the mains, it is usually followed by an arc carrying a large current Damage is usually done by the arc, and so a special device for its suppression called a Petersen coil is connected between the neutral point and the earth It is adjusted so that in the event of the capacity to earth of one of the mains being short circuited, the coil resonates with the capacity of the remaining mains and thus lowers the voltage and extinguishes the arc When an insulator

flashes over, the operation of the coil is so quick that the arc is usually suppressed before the other safety devices begin to act T W Ross and H G Bell in a paper read to the Institution of Electrical Engineers on Jan 9 discussed the merits of the various types of protective devices used for the protection of three phase lines and 'feeders' They conclude that at the present time it is possible to protect adequately the mains of a supply network by means of some of the devices that are in use, but as the networks continue to grow, still more elaborate devices will soon be required

History of Bell-founding—At a meeting of the Newcomen Society held on Dec 18, Mr A A Hughes read a paper on the art of bell founding In England, the art can be traced back to Saxon times, there being records of bells at Whitby, York, and Canterbury in the seventh and eighth centuries, while in the tenth century seven bells were presented to Crowland Abbey The earliest instructions recorded in Great Britain are contained in a manuscript by Walker of Odyngton, a monk of the time of Henry III preserved in the library of Corpus Christi College Cambridge Mr Hughes gave particulars of the methods used in designing, moulding casting, and tuning bells, and said that fundamentally the actual processes of moulding and casting have altered only slightly during the last six or seven centuries Quality of tone depends more upon correct shape and correct proportions of thickness at various points than upon the quality of metal The theory was apparently partly understood by a few early English founders, and it was certainly understood by some sixteenth and seventeenth century Flemish founders After the design is settled, a 'strickle' is used for forming the moulds which are built up from bricks and loam, the surfaces of the moulds being dressed with plumbago and polished Bell metal contains about 76 per cent copper and 23 per cent tin Great advances have been made in the tuning, the first machines for which were made at Gloucester and at the Whitechapel Foundry about a hundred years ago In olden times surplus metal was removed by hand, but vertical lathes are now used, while the note and the harmonic tones are recorded by registering tuning forks

Isotopes of Oxygen—The presence of an isotope of oxygen of mass 18 in the earth's atmosphere was reported by Giaque and Johnston (in NATURE of Mar 2, 1929, p 318), and in the December number of the *Journal of the American Chemical Society* these authors show that the atmospheric absorption spectra obtained by Babcock at Mount Wilson Observatory indicate the presence of another isotope of mass 17 A series of very weak lines is interpreted as due to the molecule $O^{16}O^{17}$, present to the extent of 1 part in 5000 as a maximum The $O^{16}O^{18}$ molecules are present to the extent of 1 part in 625 The existence of oxygen of mass 17 has previously been reported by Blackett, by Kirsch and Pettersson and by Harkins and Shadduck from data obtained on collisions between α particles and nitrogen nuclei One or two collisions per 100,000 result in combination of the α particle with the nitrogen, forming an unstable isotope of fluorine, which immediately ejects a proton and becomes oxygen 17 A full list of calculated and observed lines in the *A* bands is given in the paper

Production of Helium from Monazite—The industrial sources of helium have in recent years attracted a considerable amount of attention in view of the use of this gas in place of hydrogen for filling the gas containers of airships In the United States a considerable amount of helium extracted from natural gas, the rich varieties of which contain about 1 per cent of helium, is available and in use An alternative source of helium which is of great interest in the possible applications of the gas in the British Empire is the mineral monazite, the raw material for the production of thoria for incandescent gas mantles, which is found in large quantities in Travancore, India In the issue of Dec 27 of the *Journal of the Society of Chemical Industry*, Mr R Taylor, who has been working in the Chemical Research Laboratory at Teddington under the direction of Sir Richard Threlfall and his successor, Prof G T Morgan, describes some interesting experiments on the production of helium from monazite The mineral contains about 1 c c of helium per gram, and thus in the working up of every 100 tons of monazite about 100,000 litres of helium are allowed to escape into the atmosphere The gas escapes on heating, and the paper describes how it is purified by treatment with hot metallic calcium, which absorbs nitrogen and other gases It is advantageous to remove most of the nitrogen by heated magnesium before treatment with calcium Working drawings of the apparatus are given in the paper

Autoracemisation—The spontaneous or autoracemisation of bromosuccinic acid has been studied by T Wagner Jauregg, who discusses the reaction at some length in a paper in the *Sitzungsberichte* of the Vienna Academy of Sciences, vol 138, Suppl p 791 The author has been able to show that the racemisation, so far from being spontaneous, is catalysed by mere traces of hydrogen bromide, which are too small to be precipitated as silver halide and have hitherto escaped detection Racemisation can be eliminated either by repeated distillation under very low pressures, or by the presence of certain salts or metals such as silver, copper mercury, or zinc, but not magnesium or platinum The catalytic activity of the ions increases rapidly in the order chlorine, bromine, and iodine, the latter being nearly twelve times as active as chlorine The velocity of racemisation varies also with the solvent, acetone being very much more active than methyl alcohol Other ions appear to be inactive In discussing the mechanism of the process, the author suggests that the halogen ion on approaching the asymmetric molecule induces a charge upon it in such a way that the hydrogen atoms are detached as protons from the asymmetric carbon atoms (cf Lowry, *J Chem Soc*, p 2557, 1927) A stream of valency electrons begins to flow out through the carbonyl oxygen of the acid group to meet the free protons, thus enabling the hydrogen atoms to re enter the molecule As this process involves enolisation, the asymmetry is destroyed by the temporary formation of a double bond, so that the regenerated molecules are of necessity racemic in structure

Fuel Testing in Canada—The report of "Investigation of Fuels and Fuel Testing for 1927", issued by the Canadian Department of Mines (Ottawa, F A Acland, 1929, Paper No 696), gives a belated account of the activities of the Dominion fuel research organisation for that year The report shows that State effort is being given to encourage the domestic use of coke instead of anthracite, supplies of which are difficult This gives point to the recorded study of the coking properties of Canadian coals The gasoline survey reveals a slight deterioration in the quality of motor spirit A study of peculiarly Canadian importance deals with the assay of the bituminous sands which occur in Alberta

A Table of Electronic Configurations of the Elements

MR ROY GARDNER gave an interesting paper on "A Method of Setting out the Classification of the Elements" at a recent meeting of the New Zealand Institute The paper included the accompanying Table, which shows the distribution of electrons into groups corresponding to the principal quantum numbers for all the elements and at the same time preserves the most essential features of the two dimensional arrangement of Mendeléef Elements having the same complete groups (that is, all stable groups of 8 or 18) are placed in the same horizontal row, and the vertical columns include elements with the same number of electrons in the incomplete outer groups The electronic configurations are those given by Sidgwick ("Electronic Theory of Valency", 1927) An asterisk marks elements for which the 'normal' atom is thought to have only one electron in the outermost group, but as practically all these give divalent ions, the point is of minor interest chemically Distribution of electrons into k subgroups is unnecessary, these have at present little significance for chemical purposes, and in any case the subgroups are considered to be filled in order to the maxima 2, 6, and 10 The electronic arrangements are read off as shown by the following examples

	0	1	2	3	4	5	6	7	2 9	2 10	2 11	2 12	2 13	2 14	2 15	2 16	2 17	2 9 19	2 9 20	2 9 30	2 9 31
		H																			
2	He	Li	Be	B	C	N	O	F													
2 8	Ne	Na	Mg	Al	Si	P	S	Cl													
2 8 8	A	K	Ca																		
2 8									Sc	Ti	V	Cr*	Mn	Fe	Co	Ni	Cu*				
2 8 18			Zn	Ga	Ge	As	Se	Br													
2 8 18 8	Kr	Rb	Sr																		
2 8 18									Yt	Zr	Nb*	Mo*	Ma*	Ru*	Rh*	Pd*	Ag*				
2 8 18 18			Cd	In	Sn	Sb	Te	I													
2 8 18 18 8	X	Cs	Ba																		
2 8 18 18									La												
2 8 18																		Ce			Yb
2 8 18 32									Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au*				
2 8 18 32 18			Hg	Tl	Pb	Bi	Po														
2 8 18 32 18 8	Em		Ra																		
2 8 18 32 18									Ac	Th*		U*									

Sb 2, 8, 18, 18, 5
Fe 2, 8, 14, 2
Ce 2, 8, 18, 19, 9, 2

The existence of four types of elements is emphasised —(1) those with all groups complete, (2) those with one incomplete group, (3) those with two incomplete groups (transition elements), (4) those with three incomplete groups (rare earth elements) The upper limits of existence of covalencies of 8, 6, and 4 are marked by heavy horizontal lines

Electrical Research in Industry

ONE of the most important functions of the research department of a manufacturing company is to study the development of science with the view of its industrial application At the beginning of the War there was a wide gulf between research and industry, although it was beginning to get narrowed In 1915 there was a national movement in Great Britain to accelerate the application of science to industry, and this contributed largely to our industrial progress

We have received from Messrs. Metropolitan Vickers Electrical Co, Ltd, of Trafford Park, Manchester, an account of their research activities during 1929 This bears out how advantageous it is to make full use of scientific methods and the latest scientific developments in industry An example of this is the development of a low vapour pressure grease for use with vacuum pumps and valves This has made commercially possible the manufacture of vacuum apparatus which can be taken to pieces With the highest vacua used at the present time, grease can be used for sealing the joints which has no appreciable evaporation products The research work on the 'creep' of steels and other materials has led to important results Apparatus has been made which enables the creep characteristics to be determined immediately by comparison with a standard up to temperatures of 800° C The study of the rates of strain has enabled a tolerance limit to be fixed in turbine construction The effect of combina-

tions of various stresses in thin walled tubes has led to important results It has been found that the structural changes which occur in carbon steels at high temperatures also take place at the working temperatures of present turbine practice In all future designs, the rate of creep and permanent distortion of the steel will have to be taken into account

Many experimental turbine tests were carried out The work has demonstrated that the correct formation of blade passages in turbines varies in different parts of the machine A novel activity is the development of a means of studying nozzle efficiency by observation of the stream flow of the steam This method has now been developed to a stage where it is giving very valuable guidance on the understanding of steam flow phenomena

The quantitative tests made in the new acoustical laboratory on the noise emitted by electrical and mechanical apparatus has led to important results which are now being applied in practice The 'skin' effect produced when electric currents flow in large conductors has been studied to help with the design of bus bars for central stations In this connexion a study of the flow of heat from hot bars along irregular paths has also yielded useful results The design of induction furnaces has now advanced so far that a furnace having a capacity of one ton is being constructed

A cathode ray oscillograph has been completed, the first of its kind in England, for taking accurate oscillograms of very rapid electrical disturbances The periodic time of the instrument is of the order of the millionth of a second Much work has been done on domestic apparatus which has led to great improvements A new range of fire elements has been developed and the existing elements used in hot plates, grills, and ovens have been made more efficient and trustworthy An investigation has been made on the breakdown voltage of very long air gaps and sparks up to fourteen feet long have been obtained The safe working limits under all conditions of the high voltage testing equipment have been determined High voltage tests have been particularly useful in testing insulators for use on the national 'grid' for distributing electrical energy

Water Supply of London

IN a lecture delivered before the Junior Institution of Engineers on Jan 17, Mr G Andrew Marshall gave some interesting figures indicating the immensity of the responsibility involved in undertaking the supply of water to so great an area and population as is comprised in the district served by the Metropolitan Water Board Thus the area supplied is about 560 square miles in extent, the population 7,381,000, and the quantity of water distributed last year was 100,723 million gallons, the average daily supply being 276 million gallons, a little more than the half of which quantity was equivalent to the combined supply for Manchester, Liverpool, Birmingham, Sheffield Nottingham, Leeds, and Brighton The net amount received for water rental amounts to about £4,500,000 a year, and the capital debt is £53,856,000 The number of officers employed by the Board is about 950 and of workmen 4290 The capacity of the storage reservoirs is 19,657 million gallons, and of service reservoirs there are 92, holding 321 million gallons, there are 176 acres of filter beds, about 7000 miles of mains, and a total horse power of 27,270 is required to pump water through the system

The raw water comes from three sources, the largest, giving 58 per cent of the total, being the River Thames, 24 per cent comes from the River Lea, and the remainder from wells sunk in the Thames Valley and in Kent at Addington, Eynsford, etc Notwithstanding the great capacity—321 million gallons—of the service reservoirs, the daily quantity used—276 million gallons—makes continuous pumping necessary, and the reservoirs in many cases only serve as jack heads and cannot generally be looked upon as reservoirs for the storage of filtered water for anything but a short period

The enormous capacity of the storage—as distinct from the service—reservoirs, namely, 19,657 million gallons, is essential to compensate for the great variation in the flow of the river sources of supply at different periods of the year Thus in December 1929 the flow of the River Thames as gauged at Teddington Weir was nearly 10,500 million gallons in twenty four hours, whereas in the previous July it was only 170 million gallons, about sixty times less than the former figure It is, therefore, only possible to collect water at favourable periods of the year, and the reservoirs have to be of such capacity as to be able to span the periods of drought

In addition to storing water, the storage reservoirs have another function—the clarification of the water by precipitation of suspended particles of matter and its improvement from a bacteriological point of view Thirty days was generally considered a desirable period, in this time the number of bacteria of all kinds was reduced and the microbes of water borne disease devitalised The systematic purification of Thames water was commenced more than a hundred years ago by James Simpson, the engineer of the old Lambeth and Chelsea Water Companies, who passed it through sand filters Many improvements in this system have been made, though the principle remains the same, and in the latest developments primary and secondary sand filters are installed, the conjunction enabling the slow sand filters to be worked at a faster rate The normal rate of filtration by slow sand filters varies from 1½ to 2 million gallons per day for a bed of about 1 acre, but by passing prefiltered water on to them they can be made to work at about three times that speed

Composition of the Population of Canada.

A NEW departure by the Dominion Bureau of Statistics at Ottawa is the publication of a volume entitled "Origin, Birth, Nationality, and Language of the Canadian People" In this volume the data of the population according to the figures collected in the census of 1921 are analysed in some detail and made to afford much interesting and some times illuminating information relating to the composition of the Canadian people, especially in such matters as affect immigration in relation to growth of the population

In 1921, about 55 per cent of the Canadian people was of British stock and nearly 28 per cent French, other European stocks constituting 14 16 per cent of the population Of these, north-western Europeans (other than British or French) exceeded the Latin and Slav elements by approximately 20 per cent, though the latter group has in recent census periods been rapidly overtaking the former

In 1921, about 97 per cent of the French Canadians and three quarters of the people of British stock were Canadian born, elements from other parts of Europe

showing proportions of Canadian born ranging from 50 per cent to 80 per cent, those of the Germanic group being highest Many of the people of Scandinavian or Germanic origin reach Canada from the United States During the decades elapsing between the censuses of Canada, the proportion of the population which is Canadian-born has continued to decrease, and there has been a corresponding increase in the immigrant proportion

The various provinces of Canada present different racial textures, and it is not surprising that in Quebec 80 per cent of the population is of French origin and only 15 12 per cent of British stock In Ontario the position is reversed, more than 77 per cent being of British stock and more than 8 per cent of French stock, nearly 12 per cent being of other European origin In the prairie provinces the proportion of European stock other than British or French was three times greater than in Ontario, people of British stock representing about 60 per cent of the population of Alberta, nearly 53 per cent of that in Saskatchewan, and more than 57 per cent of that of Manitoba In British Columbia nearly 74 per cent was of British origin, slightly more than 2 per cent of French origin, and nearly 12 per cent of other European origin, persons of Asiatic origin forming in this Province 7 57 per cent The British and French stocks continue to predominate in the maritime provinces

Discussing the urban and rural distribution of the Canadian population, it is of interest to note that approximately a quarter of the population is resident in cities of 25,000 and more, the cities being more predominantly British than the rural districts Of the people of British stock, 28 17 per cent live in cities, the corresponding percentage for the French stock being 22 45 per cent

University and Educational Intelligence

CAMBRIDGE —Mr F L Engledow, fellow of St John's College, Cambridge, and University lecturer in agriculture, has been elected to the Drapers professorship of agriculture, vacant by the death on Nov 6 of Prof T B Wood

The Vice Chancellor announces that the Royal Society, in virtue of its reversionary interest in the residue of the estate of the late Mr E W Smithson, holds a sum yielding about £1200 a year, and that the regulations now published have been adopted by the Royal Society after consultation with the Council of the Senate in order to give effect to the terms of the bequest Accordingly, at the Congregation on Friday, Jan 24, the Regent House will be asked to pass a Grace to the effect that Prof A C Seward, Master of Downing, Mr W H Mills, of Jesus College, and Mr R H Fowler, of Trinity College, be appointed members of the committee for the administration of the Smithson Research Fund The Royal Society will appoint four members of the committee The income of the fund is to be devoted to the establishment of a fellowship for research in natural science with the view of the discovery of new laws and principles, to be called the Smithson Research Fellowship The research must be carried out in the University of Cambridge provided that an appropriate laboratory is prepared to offer the accommodation needed The fellow may not undertake any paid work outside the research without the written permission of the Committee The Committee will normally not withhold such permission to the holding of a paid teaching appointment in the University of Cambridge, provided that this does not involve a total of more than forty eight hours of actual teaching in any one academic year, but it will not permit the holding of an appointment for college teaching or supervision of students' work The total emolument of a fellow will be made up to £800 a year during the first two years of his tenure

LEEDS —Dr J H Richardson has been elected to the Montague Burton chair of industrial relations Dr Richardson is at present Assistant Chief of Section in the Research Division of the International Labour Office of the League of Nations at Geneva

A DISCUSSION was held on Jan 3 at the annual meeting of the Science Masters' Association on School Certificate Biology Mr J W Stork (Charterhouse) was in the chair Mr E H Michael (Swindon) opened the discussion by reading a paper dealing with the gradual growth of biology in schools, and the general problems in connexion with fitting it into the school certificate curriculum The programme of the meeting included a series of propositions which were set out in the leading article in NATURE of Jan 11 These were next discussed in turn, the chairman making it clear that they were not to be regarded as representing a syllabus, but merely as points on which the discussion might be focused Resolutions were passed recommending, among other things, that biology should be included as a separate subject in every school certificate examination syllabus, and should rank for matriculation, that school certificate biology, though intended primarily for general education purposes, must also provide preparation for specialised higher certificate work, that questions should be set in the examination which demand a practical acquaintance with experiments and types, but there should be no separate practical examination, that as few 'types' as possible should be included in the syllabus, and that the syllabus should include "An elementary knowledge of, at least, the evidences of Evolution"

UNDER Section 4 of the University of Durham Act, 1908, the Sunderland Technical College was entitled to be affiliated to the University of Durham in the Faculty of Science as soon as it had satisfied certain conditions During the past few years a considerable extension has been added to the College buildings containing a large engineering laboratory equipped with types of Diesel, steam, oil, gas, and petrol engines, air compressor, carbon dioxide refrigeration plant, and a large number of accessories, such as pyrometers, indicators, etc The materials testing laboratory has also been remodelled and the equipment brought up to date, and hydraulic plant installed for experimental purposes The electrical engineering laboratory has been enlarged and equipped with plant and instruments for tests on all types of electrical machinery, and the physics laboratory accommodation has been extended and much equipment has been added Upon the completion of this work the local education authority in May of last year made formal application for affiliation to the University The Statutory Committee appointed by the University of Durham reported favourably and invited the Chancellor of the University to declare the College to be affiliated to the University in the Faculty of Science as from the close of the present academical year Students of the College, therefore, will now be entitled to be admitted as candidates for degrees in engineering and electrical engineering in the University of Durham without being required to attend lectures or instruction other than the teaching provided by the College, and the executive authority of the College will be entitled to nominate two persons to serve on the Senate as its representatives

Historic Natural Events

Jan 26, 1884 Great Storm —The centre of a very deep barometric depression appeared off the west coast of Ireland on the morning of Jan 26, and passed across Scotland to Aberdeen, which it reached at mid night At Ochtertyre, Perthshire, the barometer fell to 27 359 inches (corrected for gravity), or 926 5 milli bars at 8 30 P M, the lowest known sea level pressure in the British Isles A severe gale was felt in north east England, the velocity at Alnwick between 11 30 P M on Jan 26 and 12 30 A M on Jan 27 averaging 76 miles per hour The Observatory on the summit of Ben Nevis was in operation at the time, and the storm there was exceedingly violent

Jan 27, 1889 Wind Storm —During a thunder storm at Sydney, New South Wales, some damage was done by a violent gust of wind One house was completely shattered, the roof being lifted off and the walls blown outwards At the Observatory three miles away, the highest gust recorded was 68 miles per hour

Jan 27, 1920 High Wind —A severe gale on the west coast of Ireland was remarkable for a gust of wind at Quilty, County Clare, which reached the highest velocity known in the British Isles The wind increased steadily in force until about 8 A M, when it was 51 miles per hour At 8 20 a violent gust occurred, the pen of the pressure tube anemograph rushed up above the top of the chart, for it caught in the upper edge and spluttered as it came down The indicated speed of the wind was at least 111 miles per hour This isolated squall did not last much more than a minute, after which the general velocity fell again to 50 miles an hour

Jan 29, 1921 Storm in Washington and Oregon —The severest storm experienced in 200 years At the mouth of the Columbia River, the wind velocity recorded by an anemometer averaged 126 miles per hour over a period of five minutes, and reached 150 miles per hour in a gust Trees four feet in diameter were broken off, the damage to standing timber being the greatest ever experienced in the United States Billions of feet of the finest timber were uprooted and thrown down, much of it was a total loss, as the district is not readily accessible for salvage

Jan 30, 1766 Dust Storm —A violent hailstorm at Gibraltar brought also enormous quantities of dust, which fell so thickly in the streets that in places it is said to have reached to the roofs of the houses, and afterwards one thousand labourers were required to remove it

Jan 30, 1911 Eruption of Taal Volcano —A great eruption occurred in Taal Volcano in Luzon Island, 39 miles south of Manila The chief feature was an explosion scattering scalding mud and ashes that ultimately formed a layer 2½ feet deep to a distance of 6 miles west of the crater The sound was heard for at least 310 miles, and the resulting atmospheric depression was registered by barographs within 186 miles of the volcano Though frequent earthquakes preceded the eruption for three days, no attempt was made to save the inhabitants, nearly all of whom (1335 in number) perished (see under heading Jan 12)

Jan 31, 1918 Fog —With an anticyclone over western Europe, the three days Jan 31–Feb 1 were foggy at many places in Europe, and on Jan 31 occurred the densest fog recorded in London for many years It began to form in the City on the afternoon and evening of Jan 30, but under the influence of light easterly airs it drifted up the Thames Valley, and at the same time increased in intensity During the afternoon and early evening of Jan 31 rail and road traffic was completely paralysed over all the low ground from Hammersmith to Twickenham, and in many places vision was limited to not more than a yard It was a typical example of shallow radiation fog, ending against the slopes of the hills almost as abruptly as a sheet of water

Societies and Academies

LONDON

Royal Society, Jan 16 —**J R Marrack** and **F C Smith** The composition of diphtheria toxin—anti toxin floccules The floccules formed by diphtheria toxin and antitoxin closely resemble serum pseudo globulin Their ultra violet absorption curves are identical The amount of precipitate obtained from a balanced mixture of a given toxin and antitoxin is to a large extent independent of the conditions under which flocculation takes place, particularly of the amount of non specific protein present Lipoid material forms a very small fraction of the floccules The authors consider that the floccules consist mainly of antitoxin, and infer that antitoxin is not merely carried down in the pseudoglobulin fraction but actually is pseudoglobulin —**F G Spear** The delayed lethal effect of radium on tissue cultures *in vitro* Cultures *in vitro* of the choroid and sclerotic of embryo chicks were exposed for varying periods to gamma rays from radium and were afterwards subcultivated every forty eight hours When a delayed lethal effect followed ex posure to radium, it occurred sooner in those cultures which had been exposed to the greater intensity of irra diation for a shorter time than in those subjected to a lesser intensity for a longer time, the product of milli grams of radium and hours of exposure being the same in a given comparison **Sir Frederick Keeble, M G Nelson**, and **R Snow** The integration of plant behaviour (1) Separate geotropic stimulations of tip and stump in roots In seedlings of *Zea Mays* a geotropic stimulus can be transmitted across a dis continuity from a coleoptile tip or root tip to an un stimulated root stump Conversely, the sensitivity to gravity of a geotropically stimulated root stump is increased by an unstimulated coleoptile tip placed upon it, and probably also by an unstimulated root tip — **Charles Todd** Cellular individuality in the higher animals, with special reference to the indi viduality of the red blood corpuscle It is possible in the fowl, by means of simple immunity reactions, to differentiate red blood corpuscles of any particular fowl from those of any other individual of the same species, except in certain cases where there is close blood relationship It appears probable that in the higher animals this individual specificity of the red blood corpuscle is only one example of a general rule applying to most cells of the body —**J Ewles** and **J B Speakman** Examination of the fine struc ture of wool by X ray analysis Photographs have been obtained showing for the first time that wool has a definitely fibred structure The three types of wool investigated in the unstretched state suggest an in teresting transition in structure Cotswold wool has definitely ordered structure and its strongly fibred pattern indicates an elongated cell Geelong 80 merino wool, though fibred, is less so than that of Cotswold wool and suggests an ellipsoidal cell 64 merino wool shows only a trace of ordered arrange- ment and fibring The three types suggest the mode of development The wool cell probably begins as a gelatinous spherical cell, by elongation in the direc- tion of growth, strains may be set up which will give rise to ordered and preferential arrangement, tending to the crystalline state

Mineralogical Society, Jan 14 —Sir Douglas Mawson On the occurrence of potassium nitrate

near Goyder's Pass, M'Donnell Ranges, Central Australia The nitre occurs as encrustations on the walls and impregnations in the wall rock in small caves in dolomitic limestone The roof of the caves consists of a case hardened crust formed by superficial silicification and ferruginisation of the limestone, and it is this impervious crust that has enabled the nitrates, probably of animal origin, to be preserved Mention is made of some other occurrences of mineral nitrates in Australia —**Louis T Nel** A new occurrence of zunyite near Postmasburg, South Africa The mineral zunyite, previously known only from Colorado, has been found in some abundance in altered, highly aluminous, shales and flagstones in the vicinity of the deposits of manganese ore of the Postmasburg District in Cape Province Minute perfectly developed tetrahedra are aggregated in clusters or are disseminated through the rock, which contains also diaspore, kaolin, and leverrierite Most of the tetrahedra are simple, but a few are interpenetration twins with a triad axis as twin axis Analyses agree with the formula $Al_8(OH, F, Cl)_{18}(SiO_4)_3$

PARIS

Academy of Sciences, Dec 23 —**A Danjon** Results obtained during the eclipse of May 9, 1929, by the expedition of the Strasbourg Observatory to Poulo Condore The period of the eclipse was troubled by clouds, but the whole of the projected programme was carried out Three photographs of the corona taken during totality are reproduced in the paper —**A Michel-Lévy** and **H Muraour** The microscopic examination of colloidal powders in polarised light Contrary to the views hitherto held, it is shown that, with explosives of mixtures of nitroglycerine with gun cotton, the examination in polarised light clearly differentiates the different types of powder, as regards the unequal distribution of the proportion of nitric nitrogen The microscopic examination and the determination of the rapidity of combustion are always in agreement, the latter being invariably higher, for the same percentage composition, when the polarising microscope indicates the presence of strongly nitrated fibres of nitrocellulose —**P Mondain-Monval** The spontaneous inflammation of mixtures of air and hydrocarbons The influence of concentration A summary, with diagram, of the results of preceding papers Generally, even when there is no inflammation, a sudden spontaneous increase of pressure is observed in the bomb, an increase impossible to differentiate by external manifestations from a true combustion —**Const Kténas** The limits of the mixed Ægean region An attempt at a geological synthesis —**Paul Wintrebert** The equilibrium changes of the egg and the position of the blastopore in the course of the development of *Discoglossus pictus* —**Jules Amar** The respiratory adaptation of the heart —**Brocq-Rousseu, Mme Z Gruzewska, and G Roussel** The relation of the hydrolysing power of the amylase of horse serum to the serum proteins —**F Vlès, A de Coulon, and J Nicod** Experiments on the action of the amino acids towards tar tumours in mice Treatment with amino acids, alone or mixed, showed several cases of cure of the cancerous tissue in others the normal growth of the tumour was arrested

CRACOW

Polish Academy of Arts and Letters, Nov 11 —**O Nicodym** The condition of Baire —**K Kordylewski** The variable star Tauri 41 1929 The elements are calculated from 76 observations on 15 nights between 1925 and 1929 The time of eclipse is eight hours —**W Swietoslawski** The heat of combustion of camphor, azobenzene, and hydrazobenzene For the heat of combustion at constant volume for 1 gram weighed in vacuum the values obtained are, camphor, 9248 7 cal, azobenzene, 8477 0 cal —**L Marchlewski** Phyllerythrin This substance, when recrystallised from chloroform, forms a stable compound with the latter This dissolved in pyridine, and precipitated by alcohol or by acetic acid, and this treatment repeated several times, yields pure phyllerythrin free from chloroform —**K Dziewonski, Mlle A Glasnerowna, and Mlle J Schoenowna** Researches on the derivatives of α bromoacenaphthene —**K Dziewonski, St Lepiankiewicz, J Moszew, and L Suchem** 1, 4 Dibenzylnaphthalene and its ketonic derivatives —**Z Grodinski** The lymphatic hearts of fossil reptiles

WASHINGTON, D C

National Academy of Sciences (*Proc*, Vol 15, No 11, Nov 15) —**William Duane** On the polarisation of X radiation A horizontal stream of high speed electrons passes through a vertical stream of mercury atoms in the middle of the anode and the polarisation of radiation at right angles to the electron stream was investigated by means of the scattered radiation from a block of carbon The weighted mean value for the degree of polarisation is 0 497 —**F Zwicky** On mosaic crystals It is suggested that structure insensitive properties of crystals are determined by the primary lattice and structure sensitive properties by a secondary structure superposed on the primary structure —**H P Robertson** On the foundations of relativistic cosmology A mathematical discussion leading to the view that the only possible cosmologies the intrinsic properties of which are independent of time are those of Einstein and de Sitter —**G I Lavin and Francis B Stewart** Production of hydroxyl by the water vapour discharge Excited hydroxyls are found in the discharge tube and destroyed in passing through the observation tube by some recombination reaction Intensity of the hydroxyl lines is parallel to the quantity of hydrogen peroxide found in the water condensed in the outlet trap —**Emma T R Williams** A spectrophotometric study of class *A* stars —**M Demerec** Genetic factors stimulating mutability of the miniature gamma wing character of *Drosophila virilis* —**Clyde E Keeler** (1) The occurrence of a heritable twisted nose in the house mouse, *Mus musculus* —(2) On the amount of external mirror imagery in double monsters and identical twins Mirrored features appear to be most frequent in laterally joined monsters —**S H Yarnell** Meiosis in a triploid *Fragaria* There appears to be complete pairing of non homologous chromosomes —**Karl Sax** Chromosome behaviour in *Sorbopyrus* and *Sorbaronia* Both these hybrids fruit freely, but the former sets very few seeds, cytological studies were carried out to determine chromosome compatibility and behaviour —**J C Walker, Karl Paul Link, and H R Angell** Chemical aspects of disease resistance in the onion *Colletotrichum circinans* (onion smudge) does not attack coloured varieties Black spots appear at harvest on the outer scales near the neck and, during curing and storage, the fungus penetrates the fleshy scales causing shrinking and decay A crude water extract from dry coloured scales is toxic to spores and also to thalli of the fungus Free protocatechuic acid (3, 4 dihydroxybenzoic acid) occurs in this extract —this establishes the free existence of this acid—and is one at least of the toxic agents involved —**Tracy Yerkes Thomas** On the existence of integrals of the system of partial differential equations $A^i_{\alpha\beta\gamma}=0$ in *n* variables —**Marston Morse** Closed extremals —**G A Miller** Non Abelian groups of odd prime power order which admit a maximal number of inverse correspondences in an automorphism

Official Publications Received

BRITISH

The World's Sugar Industry (Twelfth Streatfeild Memorial Lecture 1929) By Lewis Eynon Pp 20 (London The Institute of Chemistry)

Ministry of Health Treatment of Tuberculosis Analysis of Work done during the Year 1928 under the Schemes of Local Authorities for the Treatment of Tuberculosis, as shown in the Returns furnished in accordance with Memorandum 37/T (Memo 181a/T) Pp 9 (London Ministry of Health)

University of Edinburgh Animal Breeding Research Department Report of the Director for the Period September 1st 1928 to August 31st 1929 (being the 9th Annual Report) Pp 19 (Edinburgh)

The Proceedings of the Physical Society Vol 42, Part 1 December 16, No 231 Pp viii+42 (London) 7s net

Western Australia Annual Progress Report of the Geological Survey for the Year 1928 Pp 16+49 plates (Perth John Lee)

Rubber Research Institute of Malaya Bulletin No 2 A Study of the Effect of Damp Storage on Raw Rubber By B J Eaton and R G Fullerton Pp [illegible] (Kuala Lumpur) 1 dollar

Trinidad and Tobago Minutes and Proceedings of the Froghopper Investigation Committee Part 17 Pp 343 428 (Trinidad Government Printing Office, Port of Spain)

The Indian Lac Association for Research Bulletin No 3 Wax and Resin Secretion by the Lac Insect on *Butea frondosa* By M Venugopalan Pp 14 (Namkum)

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Air Ministry Meteorological Office London Southport Auxiliary Observatory (the Fernley Observatory of the Corporation of Southport) Annual Report and Results of Meteorological Observations for the Year 1928 By Joseph Baxendell Pp 28 (Southport Fernley Observatory London Air Ministry)

Department of Scientific and Industrial Research Building Science Abstracts Compiled by the Building Research Station and published in conjunction with the Institute of Builders Vol [illegible] (New Series) No 11 November 1929 Abstracts Nos 2217 2443 Pp v+387 424 (London H M Stationery Office) 9d net

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FOREIGN

Conseil Permanent International pour l'Exploration de la Mer Journal du Conseil Rédigé par E S Russell Vol 4, No 3 Pp 267 375 (Copenhague Andr Fred Høst et fils)

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Conseil Permanent International pour l'Exploration de la Mer Rapports et procès verbaux des réunions Vol 60 Procès verbaux (avril 1929) Pp 144 5 [illegible] kr Vol 61 Untersuchungen an Salmoniden mit besonderer Berücksichtigung der Art und Rassefragen Teil 1 Von Prof Dr H Henking Pp 99+4 Tafeln (Copenhague Andr Fred Høst et fils) 6 [illegible]0 kr

Proceedings of the Academy of Natural Sciences of Philadelphia Vol 81 New and Little known Madagascar Grouse Locusts (Orthoptera Acrididae Acrydiinae) By James A G Rehn Pp 477 519+plates 17 21 (Philadelphia Pa)

Ministerio da Agricultura Industria e Commercio Observatorio Nacional do Rio de Janeiro Taboas das Marés para o Anno de 1930 nos Portos do Rio de Janeiro Belem S Luiz Amarração Camocim Fortaleza Natal Cabedello Tambahu Recife, Aracaju Bahia Ilhéos e Paranaguá Pp 172 (Rio de Janeiro)

Instytut Geofizyki i Meteorologii Uniwersytetu Jana Kazimierza we Lwowie Komunikaty tom 4 Nr 48 do 56 Wyników prac Henryka Arctowskiego i jego współpracowników Pp Jana Moniaka, Stanisława Myćki Henryka Orkisza Adama Schmucka Henryka Stattnera Edwarda Stenza Adama Tabora Zbyszka Juljusza Zielinskiego i Stanisława Zycha, przedłożonych Towarzystwu Przyrodników im Kopernika i ogłoszonych w czasopiśmie Kosmos t 53 i 54 Pp viii+381 886+188 [illegible] (Lwów)

Bulletin of the American Museum of Natural History Vol 58 Art [illegible] Studies on the Evolution of the Pelvis of Man and other Primates By Harriet Cutler Waterman Pp 585 642 (New York City)

University of California Publications in American Archaeology and Ethnology Vol 24 No 4 The Valley Nisenan By A L Kroeber Pp [illegible] [illegible] cents Vol [illegible] No [illegible] The Bear River Dialect of Athapascan By Pliny Earle Goddard Pp [illegible] 324 40 cents (Berkeley Calif University of California Press London Cambridge University Press)

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Electro Medical Apparatus (Publication No E[illegible]) Pp 16 (London Newton and Wright Ltd)

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Diary of Societies

FRIDAY JANUARY 24

ASSOCIATION OF ECONOMIC BIOLOGISTS (Annual General Meeting) (at Imperial College of Science and Technology), at 4 30 —Dr Butler Some Aspects of the Morbid Anatomy of Plants (Presidential Address)

PHYSICAL SOCIETY (at Imperial College of Science) at 5 —J M Nuttall and E J Williams A Method of Examining Stereoscopic Photographs —S E Green *The Photography* of Fabry and Perot Interferometer Fringes by the Use of a Simple Optical System —Miss W A Leyshon Characteristic of Discharge Tubes under Flashing Conditions as Determined by the Use of a Cathode Ray Oscillograph —Demonstration by W E Dolan of a pH Apparatus

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts) at 5 30 —J H Clarke The Anderson Rotary Piston Engine

INSTITUTION OF MECHANICAL ENGINEERS at 6 —E Watson Smyth General Operating Experiences with the first Wood Steam Generator

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Newcastle upon Tyne) at 6 —R A MacGregor Failure of Steel Forgings and Castings through Fatigue

INSTITUTION OF CHEMICAL ENGINEERS (at Institution of Civil Engineers), at 6 30 —Dr H Levinstein Films and Fibres derived from Cellulose (Lecture)

INSTITUTION OF LOCOMOTIVE ENGINEERS (London) (Manchester Centre) (at Literary and Philosophical Society Manchester) at 7 —J R Bazin Presidential Address

WEST OF SCOTLAND IRON AND STEEL INSTITUTE (at Royal Technical College Glasgow), at 7 —F Clerf Notes on Continental Blast-furnace Practice

MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers Club, Manchester), at 7 15.—H C Lamb The Electrical Distribution System of Manchester

JUNIOR INSTITUTION OF ENGINEERS, at 7 30 —W J Rees *Refractories for Steam raising Furnaces*

LEICESTER TEXTILE SOCIETY (at Victoria Hall, Leicester), at 7 30 —F Willis Knitted Footwear

TEXTILE INSTITUTE (Lancashire Section) (at Harris Technical Institute, Preston) at 7 30 —J Starkie The Weaving of Artificial Silk

ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8 —Dr G P Crowden Industrial Efficiency and Fatigue

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Sir William Bragg Cellulose in the Light of the X Rays.

SATURDAY, JANUARY 25

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —Prof R W Chambers Sir Thomas More and His Friends (1)

BRITISH ASSOCIATION OF MANAGERS OF TEXTILE WORKS (at Manchester Athenæum), at 6 30 —F H Smith Foreign Yarn Business

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Junior Section) (at College of Technology Manchester), at 7 —J O Gray Foundry Costing

MONDAY, JANUARY 27

INSTITUTE OF ACTUARIES at 5 —C H Wickens Australian Mortality

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Prof V Bonney The Surgical Treatment of Carcinoma of the Cervix

NORTHAMPTON ENGINEERING COLLEGE ENGINEERING SOCIETY, at 5 30 —G A V Sowter Realism from Records

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting) at 7 —G V Twiss High Tension Distribution

INSTITUTION OF ELECTRICAL ENGINEERS (North Eastern Section) (at Armstrong College Newcastle upon Tyne), at 7 —L C Grant The Breaking Performance of High Power Switchgear and of a New Form of Quenched Arc Switch

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (at Great Northern Station Hotel, Leeds) at 7 15 —F A. Mason The Destruction of Materials by Micro organisms

KEIGHLEY TEXTILE SOCIETY (at Kiosk Café Keighley), at 7 30 —A Bennett Modern Improvements in Worsted Machinery

ROYAL SOCIETY OF ARTS at 8 —H J L Wright Three Master Etchers Rembrandt, Meryon Whistler (Cantor Lectures) (2)

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—Prof W Billington and H Round Bone Grafting and the Mandible Some Recent Results A Two stage Cleft Palate Operation

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall) at 8 30 —J M Wordie The Cambridge East Greenland Expedition 1929 Ascent of Petermann Peak

MEDICAL SOCIETY OF LONDON —Prof D P D Wilkie and others Discussion on The Etiology of Gall bladder Infections

ROYAL IRISH ACADEMY (at Dublin)

INSTITUTION OF THE RUBBER INDUSTRY (London and District Section) (at Engineers Club, Coventry Street, W C 2) —Hon F A Stockdale Lecture

TUESDAY, JANUARY 28.

ROYAL SOCIETY OF ARTS (Dominions and Colonies Meeting) at 4 30 —Sir Daniel Hall Settlers Problems in Kenya.

MANCHESTER UNIVERSITY CHEMICAL SOCIETY, at 5 —Dr W H Mills Some Stereochemical Problems

ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5 —Dr A P Thomson (with Bacteriological Reports by Dr W T Hillier) Psittacosis —Dr O Layton Nine Cases of Recovery from Diabetes Mellitus

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Dr F W Aston Isotopes (2)

INSTITUTION OF CIVIL ENGINEERS at 6 —G Lacey Stable Channels in Alluvium

MANCHESTER ATHENÆUM TEXTILE SOCIETY (at Manchester Athenæum), at 7 —H P Curtis The Automatic Loom

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7 —J L Thomson The Technical Applications of X Ray Stereoscopy —R B Archey Photographic Emulsion Spots of Biological Origin

INSTITUTION OF AUTOMOBILE ENGINEERS (London Graduates Informal Meeting) (at Watergate House, Adelphi), at 7 25 —S C Vince and others Discussion on Tuning Motor Cycles for Speed

SHEFFIELD METALLURGICAL ASSOCIATION, at 7 30 —B S Smith Density of Molten Steel

WEST KENT SCIENTIFIC SOCIETY (at Wesleyan Hall, Blackheath Village), at 8.30.

LONDON CLINICAL SOCIETY (at London Temperance Hospital), at 8 45 —Dr A Hurst, H S Souttar, and others Discussion on The Treatment of Gastric Ulcer

WEDNESDAY, JANUARY 29

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Prof G E Gask A Contribution to the Treatment of Epithelioma of the Tongue by Radium

EUGENICS SOCIETY (at Royal Society) at 5.15 —E. J Lidbetter Insanity Legislation and Administration (Lecture).

INSTITUTION OF CIVIL ENGINEERS (Students Meeting), at 6 30 —A. H Kennard Highways, and a Survey of Future Developments

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (jointly with Midland Centres of Institutions of Civil and Mechanical Engineers) (at Midland Institute, Birmingham), at 7 —Capt P P Eckersley Broadcasting by Electric Waves (Faraday Lecture).

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates Meeting) (at Works of Austin Motor Co , Ltd , Northfield), at 7 30 —Prof W Morgan The Value of the Institution to its Junior Members.

HALIFAX TEXTILE SOCIETY (at White Swan Hotel, Halifax), at 7 30 —J P O Callaghan Water Softening for Industrial Purposes

ROYAL SOCIETY OF ARTS, at 8 —Sir Thomas H Holland International Movement of Mineral Products during Peace and War (Trueman Wood Lecture).

ROYAL PHILOSOPHICAL SOCIETY, GLASGOW (at 207 Bath Street, Glasgow), at 8 —Prof W E S. Turner Glass.

THURSDAY, JANUARY 30

ROYAL SOCIETY at 4 30 —R. H Salaman (a) Crinkle 'A —an Infectious Disease of the Potato (b) Paracrinkle—a Potato Disease of the Virus Group —E C Smith and T Moran The Formation of Lactic Acid in Desiccated Amphibian Muscles —H G Thornton The Influence of the Host Plant in Inducing Parasitism in Lucerne and Clover Nodules —*To be read in title only* —F Kidd and C West Physiology of Fruit 1 Changes in the Respiratory Activity of Apples during their Senescence at Different Temperatures —R. N Mukerji The 'Nuclear Reaction in Apanteles sp, with Special Reference to the Secondary Nuclei and the Germ Cell Determinant of the Egg

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Prof H A. Harris The Growth of Children in Health and Disease (2)

BEDSON CLUB (at Armstrong College, Newcastle upon Tyne), at 6 15 —Prof C K Ingold Tautomerism and Conjugation (Bedson Lecture).

INSTITUTION OF WELDING ENGINEERS (at Chamber of Commerce, Birmingham), at 7 —C A Hedley Modern Improvements in Electric Resistance Welding Machines

ROYAL SOCIETY OF MEDICINE (at Wellcome Historical Medical Museum), at 8 30 —Dr A P Cawadias From Epidaurus to Galen the Principal Currents of Greek Medical Thought —Demonstration by L W G Malcolm of Some Recent Acquisitions by the Museum

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Newport) —R. D Owen Chemical Fires, Causes and Prevention

FRIDAY JANUARY 31

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion) at 4 30 —Seismic Methods in Surveying Prof A O Rankine, Dr H Jeffreys, Capt Shaw R S. Whipple, F J W Whipple Chairman Prof H H Turner

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Prof W S Handley The Papilloma and its Menace

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (Joint Meeting) (at Newcastle upon Tyne), at 7 15 —W G Thompson The Electrical Propulsion of Ships

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting) at 7 30 —F Onions Superheating

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Lord Rayleigh Iridescent Colour in Nature

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section jointly with other Chemical Societies of Glasgow) (at Glasgow) —Prof I M Heilbron Lecture

INSTITUTION OF ELECTRICAL ENGINEERS (West Wales (Swansea) Sub Centre)

SATURDAY, FEBRUARY 1

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College for Women) at 3 —Annual Meeting

ROYAL INSTITUTION OF GREAT BRITAIN at 3 —Prof R W Chambers Sir Thomas More and his Friends (2)

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch) (at Yeovil) —The Westland Wapiti in Service

PUBLIC LECTURES.

SATURDAY, JANUARY 25

HORNIMAN MUSEUM (Forest Hill), at 3 30 —H Harcourt Things Old and New from India s Treasury

MONDAY, JANUARY 27

UNIVERSITY OF LEEDS, at 5 15 —Prof R V Wheeler Pyrolysis of Hydrocarbons

UNIVERSITY COLLEGE, at 5 30 —Prof J Macmurray The Philosophical Approach to Modern Social Problems (Succeeding Lecture on Feb 10)

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford) at 7 —J G Stewart Farming Problems in East Anglia

WEDNESDAY, JANUARY 29

UNIVERSITY COLLEGE at 5 30 —Miss A S Cooke Recent County Library Developments

THURSDAY, JANUARY 30

KING S COLLEGE, at 5 30 —Prof R J S McDowall The Control of the Circulation (Succeeding Lectures on Feb 6, 13, and 20)

UNIVERSITY COLLEGE, at 5 30 —A D Lindsay The Relations between Ethics, Economics, and Politics (Jevons Memorial Lectures). (Succeeding Lectures on Feb 6 13, and 20)

SATURDAY, FEBRUARY 1

HORNIMAN MUSEUM (Forest Hill), at 3 30 —D Martin Roberts London in the Tudor Age

CONVENTION AND EXHIBITION

FRIDAY, JANUARY 31

ELECTROPLATERS AND DEPOSITORS TECHNICAL SOCIETY (at Northampton Institute, Clerkenwell)

At 2 —Convention, and Exhibition representative of Modern Scientific and Practical Advances in Electro Deposition

At 4 —Dr W Rosenhain Research and Practice

At 7 30 —Discussion on The Present Position of Chromium Plating.

SATURDAY, FEBRUARY 1, 1930

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No 3144, Vol 125]

National Museums and Galleries.[1]

THE Royal Commission on National Museums and Galleries has completed its labours by the issue of Part 2 of the Final Report Appointed in July 1927, the Commissioners were given the task of reporting on the administration, buildings, cost, and indeed every phase of the activities of twenty institutions containing national collections situated in London and Edinburgh An Interim Report was published in September 1928, and the Final Report testifies to the satisfaction which the Commissioners felt in the endorsement of their first recommendations by the Government and by public opinion The final reports are models of clarity, and bear in mind the national need for economy in the public services, differentiating between what is immediately necessary and what is desirable Above all, the reports are practical, so far as possible avoiding ideas of change in the governance and methods of the national institutions, provided that they have worked reasonably well in the past Since many recommendations may be put into effect by the authorities of the institutions concerned, we trust that they will at once receive the closest attention, for there is little doubt that the Commission has accurately expressed leading representative opinion

In the present report the museums and galleries of Great Britain are considered in turn Their sixteen governing authorities are not to be altered seriously, this being the natural consequence in the previous report of the recommendation of a Stand ing Commission charged with the duty of securing co ordination and reviewing estimates The govern ance of the British Museum is a pseudo hereditary or hierarchic matter, and this is likely to give as high an average of intelligence as could be obtained by any other methods The power in any event is mainly in the hands of the 'elected trustees', and after all it is difficult to imagine a more impartial electing body than the Archbishop of Canterbury, the Lord Chancellor, and the Speaker of the House of Commons, who themselves are largely selected for their power of judgment of men

While it may be admitted that practising scien tific men are not always the best acquainted with the needs of science, we think that they should not be wholly unrepresented in the 'elected trustees' These need not be appointed for life, and it is of vital importance in science to have representation

[1] Royal Commission on National Museums and Galleries Final Report, Part II Conclusions and Recommendations relating to Individ dual Institutions Dated 1st January 1930 (Cmd. 3463) (London H.M Stationery Office, 1930) 2s net.

of the younger generations, since each science revolutionises its immediate aims about every twenty years The Natural History Museum is a vital unit in the science of biology, and its future position and usefulness depend on the due fitting of its wheel with many others, most of which are perhaps represented solely in research institutions and universities Of such bodies we would not advocate any direct representation, but the payment of due regard to the lines along which biology is advancing, by the selection as trustees of men active and distinguished in research and administration, is a matter which scarcely requires argument

The Director of the Natural History Museum, as has been proposed by all committees of inquiry, is to be made "wholly responsible for the care and custody of the collections housed therein" The Commission points out that this would require a short Act of Parliament, and, being clearly doubtful of the fate of its recommendation, suggests that the Director at once be given direct access to the Treasury in all matters affecting his museum We trust, however, that there is no doubt in this matter, and that the requisite steps may be taken to restore the original plan of the legislature, thus rectifying the organisation in accordance with the demand of practically all biologists As by Darwin and Huxley in the past, so by biologists to day, the independent responsibility of its Director is deemed to be essential for the development of the Natural History Museum in accordance with modern views

The Commissioners point out that such development will entail as a consequence that the Museum takes a more active part in expeditions abroad, since the mere collection of animals and plants for the sake of acquisition is of relatively small use compared with definite objectives in respect to particular problems An increased grant is recommended, and a staff adequate to the duties which it is called upon to perform Amongst these might be the attempt to increase the educational value of this institution, and a close study of the thoughts of the Commission as to the Science Museum might suggest several lines of evolution of great value

The need for a lecture theatre for these and other museums on the South Kensington site is endorsed, but it is suggested that, by arrangement, the new theatre of the Royal Geographical Society might satisfy present requirements This theatre will hold 1000 persons, and this is the maximum size proposed by the Commission It is not big enough for important meetings of the Society, and we think that, with the development of interest in science, a theatre of at least twice this size is essential, inviting alike the leading men in science and the educated mass in our metropolis It is essential to the contemplated increase of the Science Museum, so as to give full educational facilities, which is now recommended by the immediate erection of its central block

The question of the herbaria at the Natural History Museum and at Kew is faced The Commission has evidently given much time and thought to this question The members of Sir Michael Foster's committee in 1901, with one exception, were in favour of concentration at Kew The Commission endorses this as the ideal to be aimed at, but in view of the complications and difficulties to be met, refrains from making any definite recommendation It is suggested that if the combination could be effected, Great Britain would possess "a centre for botanical study which would be without a rival in the world" This raises a question as to the reasons for exhibiting botanical or indeed any preserved specimens at all in the Natural History Museum Beautiful and interesting plants and animals, with attractive labels, can teach much, and it might be advisable to retain and develop the exhibited series of plants at South Kensington for the instruction of the public, while relegating research collections to Kew Again, a possible division of plants (as into water and land forms, *sensu largo*) might perhaps be worth considering, or research on the algæ and fungi might be concentrated in the Museum Again, Kew is celebrated the world over for acclimatisation and horticulture, and the British Museum for its possession and knowledge of type specimens, possibly a correlation would be useful which emphasised these characters

The chief reason against the concentration of the botanical type collections in one place is the capital expense entailed, but this does not apply to the Geological Museum and Survey, the ground for the new building of which is now being cleared close to the Geological and Mineralogical wing of the Natural History Museum The Geological Museum is 'a research institution', but it is not to be treated as such since one of the best sites in the metropolis is assigned to it and a large part of its building is designed for exhibition It interdigitates with the biological side of geology, the central institution for which is the Natural History Museum The latter in its mineralogical division also possesses collections of great beauty and of high importance,

which obviously in their present surroundings can never receive the consideration they demand or attain the popularity they deserve We are surprised to see in the report no specific reference to them, since their present position is a matter of common discussion, and if they were suitably housed the space they occupy would be immediately utilised for other purposes As the Natural History Museum must extend its energies into the field, and as its exhibited series depends on research, we dislike the differentiation implied above in the term 'a research institution' It is not too late for the two authorities concerned to review all the facts between themselves, and it might be economical to relieve the officers of the Geological Survey, who are chosen for research, from all responsibility for exhibition

The Commission concludes with observations on the adequacy and recruitment of the staffs of the national museums and galleries, but so diverse are the requirements that it can only offer some general considerations As in most scientific institutions, there is a deficiency in the clerical staff, so that there is a wastage of the energy of the senior officers, who are specialists The recruitment is under Civil Service rules, which are designed on the idea that a young man of a certain ability can be taught anything to a fair level This is so, but museums and galleries require certain sections of feeling and learning developed to a supreme degree, if their work is to be properly carried out Both taste in display and powers of research require characters which are not usually shown until beyond the normal age of recruitment An investigation of the whole matter is suggested, but we are doubtful whether this is likely to secure results of any importance Brief courses in universities may lead to a level of mediocrity, which may well be deplorable in its results

We would be inclined ourselves to suggest the general adoption by the national museums and galleries of the system of pension insurance now in vogue in most of our educational institutions Thereby the freest interchange would be possible in each section of learning, and inevitably the most suitable curators would gravitate towards the national institutions, upon which the schemes adopted in the provincial museums and galleries depend It would appear to us a natural step in the unity of learning and research, to promote which unity is the highest function of any university, society, or institution for the furtherance of knowledge The greatest of these may be the British Museum

Brighter Chemistry

At Home among the Atoms a First Book of Congenial Chemistry By Prof James Kendall Pp xv + 270 + 16 plates (London G Bell and Sons, Ltd, 1929) 7*s* 6*d* net

SOMEONE has spoken of chemistry as a science of symbols, and in a sense the allusion is apt, since a skilful system of symbolic representation has lightened the labours of the chemist as much as the wonderful decimal notation has shortened the processes of the mathematician The peculiar force of a paradox is therefore lent to the reflection that this prime clarifying influence of modern chemistry is a direct outcome of the obscurantism of medieval alchemy From very early times, indeed, chemistry has been closely bound up with symbolism and mysticism in ancient Egypt a knowledge of chemical secrets was the jealously guarded prerogative of priests and kings, and at a later day the "sons of Hermes" enmeshed their "precious pearls" of alchemy in a web of enigma, cryptogram, and obscure expression which maintained the high standard of unintelligibility of their patron's famous Smaragdine Table

Thus, in his "Cours de Chymie", published in 1675, Nicolas Lémery had ample reason to complain that "la plûpart des Auteurs qui ont parlé de la Chymie, en ont écrit avec tant d'obscurité, qu'ils semblent avoir fait leur possible pour n'être pas entendus" Lémery himself was so successful in stripping chemistry of its mysticism that he produced a comprehensive and intelligible text-book which may be read with pleasure even at the present day So the "Cours de Chymie", which for the first time presented the naissant science to the world in all its native simplicity, became literally a 'best seller' of the seventeenth and eighteenth centuries, it passed through numerous editions in various languages, and held its place as the authoritative work on chemistry until the time of Lavoisier

The epoch making "Traité élémentaire de Chimie", published in 1789, swept away the last remnants of mysticism, while Dalton's "New System of Chemical Philosophy" afforded an indication, some twenty years later, of the coming resurgence of symbolism in the cause of progress Since the birth of the atomic theory there have been innumerable works dealing with the rapidly expanding science from various points of view, and ranging in size and cost from the lordly and misnamed 'handbooks' of Beilstein and others to plebeian sixpenny primers Lemery, as we have

seen, presented his information in an attractive form He had, in the words of Hoefer, "le talent de décrire les choses les plus obscures et les plus arides avec une simplicité et une précision remarquables" Unfortunately, the same cannot be said of some of his successors, for, on the whole, chemical writers have become more formal and arid as knowledge has accumulated

In the early days of the atomic theory, however, popular expositors of the science were not wanting Among such writers we may well pause to pay a tribute to Jane Marcet and John Scoffern for how many contemporary students of chemistry have so much as heard their names! Jane Marcet's "Conversations on Chemistry" first appeared in 1805, and ran through many editions during the succeeding fifty years The text took the form of a conversation between a certain Mrs B and her two pupils, Caroline and Emily

"To confess the truth, Mrs B," says Caroline boldly, at the outset, "I am not disposed to form a very favourable idea of chemistry, nor do I expect to derive much entertainment from it I prefer the sciences which exhibit nature on a grand scale, to those that are confined to the minutiæ of petty details I grant, however, there may be entertaining experiments in chemistry, and should not dislike to try some of them the distilling, for instance, of lavender, or rose water "

In countering this frank avowal, Mrs B points out that Caroline's "want of taste" for chemistry is a consequence of her limited ideas "You confine the chemist's laboratory to the narrow precincts of the apothecary's and perfumer's shops, whilst it is subservient to an immense variety of other useful purposes Besides, my dear nature also has her laboratory, and there she is incessantly employed in chemical operations You are surprised, Caroline, but I assure you that the most wonderful and the most interesting phenomena of nature are almost all of them produced by chemical powers "

If modern ambition should feel disposed to mock such useful pioneering toil, it suffices to quote a passage from one of Faraday's letters

"Mrs Marcet was a good friend to me," he wrote to de la Rive, "as she must have been to many of the human race I entered the shop of a Book seller and book binder at the age of 13, in the year 1804, remained there eight years, and during the chief part of the time bound books Now it was in those books, in the hours after work, that I found the beginning of my philosophy There were two that especially helped me, the *Encyclopaedia Britannica*, from which I gained my first notions of electricity, and Mrs Marcet's *Conversations on Chemistry*, which gave me my foundation in that science You may imagine my delight when I came to know Mrs Marcet personally, how often I cast my thoughts backwards, delighting to connect the past and the present, how often, when sending a paper to her as a thank-offering, I thought of my first instructress, and such like thoughts will remain with me "

Scoffern's "Chemistry No Mystery", published in 1839, is one of the few scientific books containing illustrations by Cruikshank, who made great play in it with the effects of laughing gas and sulphuretted hydrogen The frontispiece, entitled 'Laughing Gas', has a truly Pickwickian motif "Some jumped over the tables and chairs, some were bent upon making speeches, some were very much inclined to fight, and one young gentleman persisted in an attempt to kiss the ladies" Moreover, the harrowing story of the lady "made beautifully white" with a preparation of the metal bismuth, who "took a bath in the Harrowgate waters, when her fair skin changed in an instant to the most jetty black", would have made a notable addition to the repertoire of Sam Weller In this entertaining and informative work, chemistry is ably expounded in a series of twenty one lectures The author's point of view is explained in the following remarks addressed to his "dear young friends" in the opening lecture

"You think", he says, "that young people cannot possibly engage themselves in the study of a science which has been cultivated by such great men as Sir Humphry Davy and Doctor Wollaston —this supposition is wrong I grant that the very highest order of intellect is often required to make a discovery, but when once made it may perhaps be rendered comprehensible to persons much younger than yourselves, and indeed I cannot think of any necessary portion of chemical science which does not admit of a very easy and agreeable exemplification"

Like his predecessor, Lémery, Scoffern practised what he preached

These were joyous days for the 'joyous science', for it was in the following year (1840) that Wohler, writing under the significant name of S C H Windler, published his pseudo serious contribution to Dumas' ideas on "Substitution and the Theory of Types" in *Liebigs Annalen der Chemie und Pharmacie* To S C H Windler's statement that "in the decolorising action of chlorine, there is a replacement of hydrogen by chlorine, and that the fabrics which are now bleached in England according to the laws of substitution preserve their

types ", the genial Liebig, entering into the fun, added in an editorial footnote, " I have just learnt that there are already in the London shops fabrics of spun chlorine, much sought after in the hospitals and preferred to all others for night caps, etc "

Later in the nineteenth century, chemical literature relapsed into a severe formalism, which has been relieved only during the last few years by the appearance of a number of treatises designed to meet the needs of the growing popular interest in chemistry The new movement towards a brighter chemistry has been borne along upon the wave of increasing interest in the human side of science, and has found its main expression among the English speaking communities of the world Prof Kendall s book is an excellent example of this new tendency in the exposition of scientific facts and principles Reducing, as he explains in his preface, the formal side of chemistry to a minimum throughout his treatment, Prof Kendall develops in a logical and systematic manner the meaning of substances, elements, atoms, and other fundamental chemical conceptions Having brought us by pleasant ways into the atomic Lilliput, he proceeds to put us " on really intimate terms " with such prominent Lilliputians as oxygen (' the working-girl—Heaven has already protected her '), hydro gen (" nice baby "), and chlorine (' gentlemen prefer blondes ') Later he conducts us around the apartment house of Mendelejeff Court, pausing *en route* to relate to his party the story of young Newlands and " the dear old Tories of the London Chemical Society "

On the first floor we meet the metals of the alkali family, on the second, we hear of radio-activity, discover that the alchemists were funda mentally right, and rewrite the constitution, on the third, we are told in an impressive stage whisper that " Al's here ! ', and eventually we wander out into the country and explore the in triguing mazes of Bohrville The whole itinerary is enlivened by interesting glimpses of the human and historical side of the subject (including, we are glad to note, a quotation from Mrs Marcet), while the dark places are unfailingly illuminated by flashes of humour, dashes of picturesque phrase-ology, and telling illustrations from the things and doings of everyday life, the book also contains numerous explanatory diagrams and plates " Read Sir John Mandeville's Travels to cure you ", was the advice of Charles Lamb the convalescent of a later and more scientific age may be recom mended to join in Prof Kendall's personally conducted tour among the genuine marvels of the atomic world

Up to the present, the revivification of chemical literature has not extended to the periodicals, and if we suggest that the circulation of any one of our standard chemical journals would increase by leaps and bounds if only every hundredth com munication were written by a modern S C H Windler, we may perhaps anticipate a reply from " the dear old Tories " in the sense of the concluding words of the excellent Scoffern " As a young lion torn from the forest is tame and playful, allowing caresses, and joining in every frolic, so we found chemistry, but as it grew up to its full size and strength, it became a thing no longer to be played with, demanding all care, attention, and respect "

JOHN READ

Prehistoric Art and Symbolism

Rock Paintings of Southern Andalusia a Description of a Neolithic and Copper Age Art Group By the Abbé Henri Breuil and M C Burkitt, with the collaboration of Sir Montagu Pollock Pp xii + 88 + 34 plates (Oxford Clarendon Press, London Oxford University Press, 1929) 63*s* net

THERE are already several important treatises on the Upper Palæolithic art in the caves of France and northern Spain There are also several memoirs on the peculiar art, probably of the same age, in the rock shelters of eastern Spain The subsequent development of this art, however, has not hitherto been exhaustively treated only a few scattered papers have shown that there is ample material for the purpose in the rock shelters of southern and south eastern Spain Since 1913, when the Abbé Breuil and Mr Miles Burkitt made some preliminary explorations and observations, the Abbe has devoted several seasons to the task of tracing all the more important examples of this later art and making notes in the field Sir Montagu Pollock has translated and edited the notes for publication, and Mr Burkitt has added some introductory and concluding general remarks. The result is a handsome volume, illustrated not only by photographs and text figures, but also by several coloured plates, of which two are due to the generosity of the Marquis of Bute

The art under consideration is definitely proved to be later than the Palæolithic art of eastern Spain, because it extends into the same area and is sometimes represented in the same rock shelters When the two sets of paintings are superposed,

those of the Palæolithic phase are underneath The later art, however, is not characteristically eastern it has been traced over the greater part of southern Spain, and its centre seems to be Andalusia It is expressed chiefly in small paintings made by using the oxides and carbonates of iron, probably mixed with fat which has disappeared, and it is preserved only in shelters which are dry There are very few engravings

The paintings, which are usually only a few centimetres in diameter, are of particular interest, because they are not naturalistic but reduced to conventional designs, often no more than symbols The human figure is especially common, and a female is often represented with clothing and head dress A form of deer is the only abundant mammal, and the multitude of birds is especially noteworthy When well preserved, as in the Cueva de las Figuras, in the south west of the Sierra Momia, the paintings are so numerous and conspicuous that they have long been known to the local people, who regard them as the handiwork of the Moors

The detailed descriptions and coloured illustra tions begin with the shelter or 'cave' of Las Figuras, in which there are more than five hundred separate paintings, not grouped into scenes Every noteworthy figure is mentioned and explained, and besides several photographs of these figures, there are also many beautiful photographs of the various shelters themselves and the country surrounding them The whole forms a most valuable work of reference for the student, who may draw his own conclusions, and will be grateful for the guidance afforded by Sir Montagu Pollock's introductory note In this note, series of conventional paintings of the human figure are collected, to show how the recognisable outline may degenerate into a symbol which would be inexplicable if the successive gradations were not forthcoming In one series, a man passes into something like a Greek ϕ, in another to a cross, in a third to a star A multi plication of the arms (as in the case of certain Indian deities) produces a still stranger ultimate figure A deer, by the multiplication of the legs and the loss of the head and neck, passes into something like a comb The beginning of symbolism is indeed most evident

The authors suppose that some of the paintings are considerably older than the others, and suggest the possibility that there is a connexion between the earliest of them and the markings on the well known Azilian painted pebbles Mr Burkitt, however, compares the paintings of the deer and some of the symbols with similar ornament on Spanish pottery which certainly belongs to the Copper Age If the comparison be justified, most of the art now described is thus either Neolithic or slightly later This conclusion is so interesting, that archæologists will eagerly await further developments of the research A S W

Measurement of Animal Environment

Laboratory and Field Ecology the Responses of Animals as Indicators of Correct Working Methods By Prof Victor E Shelford Pp xii + 608 (London Baillière, Tindall and Cox, 1929) 45s net

PROF SHELFORD is one of the best known American students of animal ecology It will be remembered that, more than twenty years ago, he published a number of studies on the relations between the larvæ of tiger beetles and the soil and vegetation on the shores of lakes near Chicago, and that more recently he and his associates have been concerned in the study of the relation between the codlin moth and climate From field work of this type he has progressed in the direction of controlled work in the laboratory He has not tried to study the animals as a physiologist would, by isolating factors and devising 'good experiments' in which one factor only is allowed to vary On the contrary, he holds that the ecologist in his laboratory should aim at reproducing the complex, varying, cyclic conditions of Nature This is a legitimate view, but it is not in accordance with the general scientific maxim that work should proceed from the analysis of simple controlled experiments to the synthesis of more complicated conditions Parts of Prof Shelford's book describe the extremely complex and expensive plant, designed to give complete control of temperature, atmospheric humidity, and other factors, and to provide a great variety of combinations of them

We have found it difficult to know where the line should be drawn between ecology, physiology, and other clearly defined sciences, and some of the contents of the book under notice are unexpected On the other hand, there are some omissions which we may be permitted to point out If the index may be trusted, there is no mention of the katathermometer in spite of its recognised value in relating climatic conditions to the life of warm-blooded animals, moreover, the same instrument can be employed to measure currents of air under conditions which prevent the use of most types of anemometer Prof A C Hardy's plankton recorder

should also find a place in the book The account of the methods and results of marking migratory birds with metal bands makes no mention of what has been done in Europe this one regrets, for much work done in Britain, Germany, and other European countries has been very thoroughly carried out and summarised The list of references at the end of the book will be of great value As it does not attempt to approach completion, one can scarcely criticise the omissions, but it is noticed that comparatively few references in French or German are included Surely Mr Elton's excellent Animal Ecology " should be among the works to which the student is referred

Those parts of the book which deal with climate and its effect on animals have interested us particularly, and we find two omissions which appear to be noteworthy There is a full discussion of the relations between animals and humidity, and on the complication which is introduced by temperature, but there appears to be no allusion to the essential fact that humidity measured as relative humidity has very little biological meaning yet we know already that it is saturation deficiency which is of importance in the physiology of mammals and of plants The distinction between saturation deficiency, absolute humidity, and relative humidity is one that is appreciated by very few biologists, and had Prof Shelford stated it clearly (and possibly represented it graphically) we should have been very much in his debt

We should also like to see it recognised by ecologists that solar radiation of one type or another is the most important part of climate for plant or animal it is the least understood and studied, because meteorologists concern themselves so much with barometric pressure and the dynamics of the atmosphere In reading the section on solar radiation we discovered a curious error repeated several times it is stated that black bulbed thermometers are used for recording the intensity of *light*

The book contains a mass of information on a number of subjects We know none other which covers the same ground, and it will be continually used for reference, for its particular value lies in the descriptions of methods and apparatus It gives less attention to field ecology, and does not show the living animal set in a complex environment of climate and soil, living enemy and competitor When a second edition is called for, we hope the index will be much fuller The contents of the book are so essentially promiscuous that a full index is more than usually necessary

P A BUXTON

Fossil Plants from the Coal Measures

Coal Measure Plants By Dr R Crookall Pp 80+40 plates (London Edward Arnold and Co, 1929) 12*s* 6*d* net

THE study of British Carboniferous plants will be stimulated and advanced by Dr R Crookall's book Dr Crookall is palæobotanist to the Geological Survey of Great Britain and is also in charge of the splendid collection of Palæozoic plants made by the late Dr R Kidston, he is therefore in a position to speak with authority on Carboniferous plants The book, however, is not written primarily for the specialist or the botanist, and will recommend itself as an introduction to the subject to geologists who have had no botanical training, to amateurs, and to field naturalists It will also be of value as a book of reference for university students in connexion with courses on the Pteridophyta and Gymnosperms

The great advances in palæobotanical research made in the last century in Britain were due very largely to the enterprise of amateurs, among whom may be mentioned that group of Lancastrians, some of whom were working men, whose discoveries of 'petrifactions' of plants in the coal seams were described by Binney and Williamson Kidston was responsible for practically all the important work on Carboniferous plant 'impressions' and he received very considerable assistance from other amateur collectors, as well as from the Geological Survey, to which he acted as honorary palæobotanist But active amateur interest in fossil plants has almost disappeared in the last few decades, probably partly as a result of the complicated terrors of nomenclature and the consequent difficulty of identifying specimens Dr Crookall's book, with its clear descriptions and excellent half-tone illustrations, will help to remove this disability

In many parts of Great Britain the countryside is disfigured with waste tips from collieries, but these afford some compensation by offering a great opportunity to the student of fossil plants The shales and sandstones brought up from the workings of the mines contain abundant examples of mummified plants, which, with the help of such a book as "Coal Measure Plants", may become intelligible to the non specialist

Dr Crookall in the introductory chapter describes the nature and origin of plant fossils, with a brief account of the stratigraphy of the Coal Measures and a general review of the main divisions

of the plant kingdom encountered in them Six chapters are devoted to the detailed description of these divisions, with valuable notes on the identification of the important species, and are fully illustrated in the thirty-nine plates Kidston divided the Coal Measures, on the basis of the plants found in them, into four principal zones, each characterised by certain species and the relative abundance of others, and in the last chapter lists are given of the species characteristic of these zones In a short appendix some valuable practical advice is given to collectors A full list of the species described, with the names of their authors and an adequate index, completes the letterpress of the book

The main object the author has in view is to facilitate the identification of specimens, and he will have achieved this partly by the descriptive chapters, but mainly by the large number of plates containing illustrations of two hundred and forty species The photographs, which fill twenty one of the plates, are excellent The other plates, containing line drawings, which are used by the author to indicate distinctions between species, are on the whole good, but a few of the drawings are unnecessarily crude, and while quite effective for purposes of identification, are somewhat unsightly

We may congratulate Dr Crookall on having produced a clear and well illustrated guide to the study of fossil plants from the Coal Measures

J W

The Design of Scientific Instruments

The Kinematical Design of Couplings in Instrument Mechanisms By Prof A F C Pollard Pp 64 (London Adam Hilger, Ltd, 1929) 4*s* 6*d* net

PROF POLLARD'S monograph is a clearly written and well illustrated little book urging the application of kinematical principles in all instrument design The basis of his book is the well-known theorem that a rigid body has six degrees of freedom, any number of which can be annulled by an equal number of suitable kinematical constraints, neither more nor less This singleness of purpose, together with the author's attractive manner of writing, have combined to produce a concise and readable book, which should be closely studied by all instrument designers who are not already acquainted with the principles advocated Not the least valuable part of the book to the designer are the well-chosen examples of correctly designed instruments, which occupy actually the greater part of the book The descriptions and illustrations of these leave nothing to be desired

Prof Pollard censures the 'machine tool' type of design severely, and with certain reservations we are in full agreement with him It frequently happens in practical designing that one is reluctantly forced to abandon some kinematically correct feature on account of other considerations, such as wear of the parts or prohibitive contact stresses An example of this may be taken from the book itself A knife edge pivot is described, which is quite a beautiful example of kinematic perfection, in which the four necessary constraints are supplied by four steel spheres in contact with the edge Yet this perfect device is not applied in our balances, presumably because of the excessive elastic deformation which would occur at the four point contacts Instead of this, the modern balance flagrantly violates kinematical principles, which have to be subservient to other considerations, such as sensitivity and durability In such cases, as the author clearly explains, only perfection of workmanship can compensate, and the book strongly emphasises the sound procedure of commencing every design on kinematical principles, and only falling back on accurate machining when absolutely necessary

In the important class of movements having one degree of freedom, such as a sliding or a rotating member, the author strongly advocates the use of commercial steel balls Where instruments of high precision are concerned, it would seem well to caution designers to employ only balls which will pass a three point test for sphericity In most applications the ball is actually in contact with three different surfaces, whereas it is manufactured by a process which ensures uniformity of diameter as measured between two parallel planes, but does not necessarily produce true sphericity

In one place we should differ completely from the author, where he recommends 'Staybrite' steel as superior to hardened and ground steel, in that it does not require hardening This special non-rusting steel is in fact incapable of being hardened, except to some extent by cold working, and could not well take the place of hardened steel where hardness is the essential property The book, however, is not concerned with the materials of instrument design so much as with the principles, and its value to the designer is in no way reduced by the small point on which we have commented

Our Bookshelf.

Thyroxine By Dr Edward C Kendall (American Chemical Society Monograph Series, No 47) Pp 265 (New York The Chemical Catalog Co, Inc, 1929) 5 50 dollars

THE researches of Prof Kendall into the chemistry of the active principle of the thyroid gland are well known this monograph, however, is much more than an account of his own work, since the study of thyroxine implies the study of the physiology of the thyroid gland The viewpoint is that of the chemist who is concerned with the relationship of thyroxine to the processes of oxidation in the animal body

Although Kendall isolated the active principle in crystalline form in 1914, it was not until 1926 that Harington and Barger proved its constitution by synthesis As a result of his original analyses, Kendall had found that thyroxine contained three atoms of iodine, whereas actually four atoms are present the explanation of the discrepancy appears to be that volatilisation of traces of organically bound iodine occurred during the alkaline fusion of thyroxine, so that the molecular weight assigned was too low

Thyroxine is not the only iodine compound present in the thyroid gland Harington (*Biochem J*, vol 23, p 373, 1929) has recently isolated diiodo tyrosine and considers that only these two are present, Kendall, however, inclines to the view that thyroxine may exist in the gland in an 'active' form, since dried thyroid may have quantitatively somewhat greater activity than thyroxine, and also that other compounds are present He describes also the activities of the various substances which have been isolated from the gland and reviews the evidence on its physiological function in this connexion he refers to the clinical disorders of this functioning, in so far as they throw light on the influence of the active principle upon the chemical activities of the body This book should be in the hands of all biochemists, physiologists, and pharmacologists it will be invaluable as a work of reference, since more than five hundred papers are reviewed in the text

(1) *Youth the Psychology of Adolescence and its Bearing on the Reorganisation of Adolescent Education* By Prof Olive A Wheeler Pp xv + 202 (London University of London Press, Ltd, 1929) 5s net

(2) *The Child from Five to Ten Interests and Problems of Early Childhood* By Evelyn and Miriam Kenwrick Pp vii + 299 (London Kegan Paul and Co, Ltd, 1929) 7s 6d net

WE place these two books in juxtaposition because together they constitute a sign of the times In certain respects they differ markedly Dr Olive Wheeler's treatment of her theme is emphatically scientific, whilst the Misses Kenwrick are strong in human sympathy and in practical insight This is by no means to say, however, that Dr Wheeler is not human, or that the Misses Kenwrick are not scientific Each writer gives of her best, and her best is very good

(1) Dr Wheeler has chosen the more familiar ground, for the psychology of adolescence has a considerable literature of its own But besides giving us a more manageable book than Stanley Hall's, and a more adequate one than Dr Slaughter's, she has brought her account abreast of recent inquiry, including work of her own, and has thought out her subject in connexion with the questions of educational reorganisation that confront England at the present time "Youth" is both an able and a timely book

(2) In a sense the Misses Kenwrick break new ground, for the period between infancy and adolescence has not received so much attention from psychologists as those two periods, the one so full of charm, and the other so full of peril But the child from five to ten, or at any rate from seven to eleven, is destined to become a definite educational problem by himself, so we welcome this book The writers owe nothing to the method of the questionnaire, or to any studies on the extensive scale But their keen insight, their experience as teachers, and their adequate psychological equipment, have enabled them to give us valuable intensive studies of individual children

An Historical Catalogue of Surrey Maps By Henry A Sharp Pp 56 (Croydon The Central Library, 1929) 3s 6d net

THIS is a handy catalogue of those maps of Surrey which find a place in the Croydon Public Libraries The list is arranged in chronological order, and the first entry of an original map is Peter Keer's map of Surrey of 1599, published by Speed We then find entries of maps by Norden, Speed (engraved by Jodocus Hondius), in many forms, Blaeu (1648), Jansson, Blome (engraved by Hollar), Morden (1695), Seller, "Surrey actually survey'd and delineated" (1733), Rocque, on the large scale of 2 inches to the mile (1762), until we come to John Cary (1754–1835), and the beginning of the more modern type of map There are altogether 176 different maps or editions tabulated and described, and the work has evidently been a labour of love for the author

There is an excellent introduction in which the reader will find a great deal of information about the maps of Surrey, and some other matters, such as the story of Mr Smyth and his Dog A useful addition in any future issue would be some information as to the amount and value of the original field work which forms the basis of the maps, some account, for example, of Saxton's actual surveys Saxton was born about 1542, and he has been called the first English cartographer Keer reduced his maps from Saxton, but it was Saxton who did the field work Some description of Cary's actual surveys would be of value, and generally, it would be of interest to discriminate between those cartographers who used new material, and those who merely made a re hash of previously existing maps

It might be as well, in future editions of this catalogue, to rearrange the entries relating to the Ordnance Survey 1 inch maps The present arrangement is not perfectly systematic

Problems of Neurosis a Book of Case Histories By Alfred Adler With a Prefatory Essay by Dr F G Crookshank Edited by Philippe Mairet Pp xxxvii + 178 (London Kegan Paul and Co , Ltd , 1929) 8s 6d net

THE number of books in English on Alfred Adler's contributions to psychology grows, and the present volume is certainly not the least interesting of them. The principles and practices of 'individual psychology' are exemplified by a number of case histories The book thus resembles "The Case of Miss R", which appeared in an English translation some time ago, but it is more comprehensive

We are strongly inclined to think that anyone desiring a clear introduction to Adler's way of thinking will do better to begin with "Problems of Neurosis" than with the more formal treatment to be found in other books They will also realise that, like Freud, he gives a doctor's rather than a teacher's psychology, although no hard and fast distinction can be drawn between the two This view is strengthened by the fact that Dr Crookshank, a medical man, introduces the reader to Adler's text In doing so he gives a clear and helpful account of the individual psychology

The convinced Freudian may continue to assume the dominance of the sexual factor in, let us say, the interpretation of dreams Others, and we believe a majority of students of psycho analytic literature, will agree with Adler that the sexual factor is determined by the goal of superiority We think that this book strengthens Adler's position, and at the same time makes a very readable addition to the literature of the subject

Descriptive Sociology or, Groups of Sociological Facts, Classified and Arranged by Herbert Spencer No 13 *Mesopotamia (The Ancient Inhabitants of the Tigris Euphrates Lands)* Compiled and Abstracted upon the plan organised by Herbert Spencer, by Reuben Levy Issued by Mr Spencer's Trustees (T W Hill, Editor) Pp iv + 49 + 4 tables (London Williams and Norgate, Ltd , 1929) 42s net

THIS wonderful collection of snippets goes on as before The compiler's industry and the trustees' funds would appear to be practically wasted in the preparation of a commonplace book for the late Mr Spencer, who is not here to consult it Under the heading "General Government Hittites" there is this and nothing more "*Taxation* The man who is given absolute possession of landed property must pay a tax on them" (whom ?) If the possession "is only partial, he need pay no tax (*A O*, xx p 11)" How helpful in dealing 'sociologically' with Income Tax Schedule A how futile, otherwise ! J L M

Glue and Gelatine By Paul I Smith Pp x + 162 (London Sir Isaac Pitman and Sons, Ltd , 1929) 8s 6d net

THE author's general survey of the subject, given within a modest compass, should be of interest and use to the technologist and manufacturer The book includes a consideration of the raw materials used in preparing glue, gelatine, and isinglass , the preservation of stock by the glue manufacturer , the plant used in filtration, evaporation, and other general operations , the analysis and uses of glue and gelatine together with some historical notes

The chapter on the chemistry of proteins needs careful revision In the note on amino acids (p 21) the prefixes α and β should be interchanged , the structure attributed to alanine is incorrect , and the representation of the primary amino group may convey the idea that it is bivalent Esters are misrepresented in the first two structural formulæ on p 24 , on p 30 leucine is termed "lencin", and its molecule is credited with a primary amino group attached directly to a carboxyl group ! Another quinquevalent carbon atom is represented on p 138 Comment is also invited by the use of such expressions as "a strata" (p 39) and "good quality glue" (p 54) The book is well printed, and it contains some interesting illustrations

Creation by Evolution a Consensus of Present day Knowledge as set forth by Leading Authorities in Non technical Language that all may Understand Edited by Frances Mason Pp xx + 392 + 22 plates (New York The Macmillan Co , 1928) 21s net

THERE is much to be said for the method adopted by the editor of associating short essays on different aspects of evolution, each written by a specialist, as a body of evidence designed to appeal to the general reader If there is bound to be a certain amount of repetition, as when the recapitulation theory or the origin of birds from reptilian stock is discussed by different authors, or a certain amount of inconsistency, as, say, in the attitude adopted towards 'species', these weaknesses are more than atoned for by the variety of style and outlook of the individual contributions The editor has been fortunate in obtaining as witnesses to the reality of evolution some of the best known biologists in Great Britain and the United States, and the twenty six essays, which cover an extraordinarily wide and interesting field, are marked by a simplicity of statement (and occasional dogmatism) which will appeal to the plain man

Lehrbuch der Geophysik Herausgegeben von Prof Dr B Gutenberg Lieferung 5 (Schluss) Pp xx + 797 1017 (Berlin Gebrüder Borntraeger, 1929) 18 gold marks

THE fifth and last part of Gutenberg's "Lehrbuch der Geophysik" has now appeared Most of it deals with meteorology, and is by Dr L Weickmann The chief instruments are described, and most of the existing theoretical work is outlined The result is a handy book, with copious references to original papers, which has long been needed There are some curious omissions , for example, the chapter on atmospheric friction does not contain the name of G I Taylor or of L F Richardson The perfect book on dynamical meteorology will not, however, be written for some time, and meanwhile Weickmann's work is a useful approximation H J

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

Early Rhodesian Gold

I HAVE not the intention of entering into the correspondence which I hope to see develop further out of Prof J W Gregory's letters in NATURE of Nov 9 and Jan 11 If, however, that correspondence is to be profitable to science and clear thinking, may I ask that precise information be given on certain points which have been once more resurrected ? For example

(a) *Roman Coin from Umtali* —Who found it ? Who has seen it ? What were its associations when found ? I made inquiries of course, in Rhodesia, but even the late Mr R N Hall had, it seems, given up faith in it The history of other coins of antiquity purporting to be South African finds is, when investigated, no more satisfactory See Prof Dart's article, NATURE, Mar 21, 1925, and Mr Schofield's devastating retort, Mar 27, 1926

(b) *Soapstone Birds on Beams* —What parallels sufficiently close to pass morphological muster are provided by ancient Egypt and Assyria ? Who has published them ? For one would wish, when these birds come to London in the spring for temporary exhibition at the British Museum, to place their counterparts beside them for comparison This I shall also hope to see done with the ' Rosette ' Cylinder

(c) *Ptolemaic Beads* —Who ' referred ' them to this source ? I am of course, acquainted with Bent's reference He says ("Ruined Cities of Mashonaland", p 204), "beads of doubtful provenance, though one of them may be considered as Egyptian of the Ptolemaic period " They were found ' in the vicinity of the Temple " very near the surface What were their associations ? Celadon, Arab glass, and Persian ware Deposits, like ladies, have the fortune to be dated by their youngest feature

(d) *Proto Arabic Inscription* —Where was it found and where published ? Bent published ("Ruined Cities of Mashonaland", p 199) an ' inscription ' on a soapstone bowl, and supposed letters on a rock in Bechuanaland These were elaborated by Keane, with the result recorded in the *Geographical Journal*, April 1906, p 346 I have looked at all the bowls in museums but could not identify Bent's inscription The soapstone bowl fragments we found are a mass of scratches

Further why is that nice eighteenth dynasty Ushabti figure from Ndanga always left out of the argument ? Its value as ' evidence ' is not less remarkable than that of the other relics mentioned

Two more questions (1) When mining authorities of eminence differ in their estimate of the gold production by £60,000,000 (maximum £75,000,000, minimum £15,000,000), what is the archæologist to do ? I can only suggest that he should read Theal's "Records" carefully, and examine the relics from ' ancient workings ' at Bulawayo and Salisbury (2) When a coin of Antoninus Pius is found in a mine shaft at Umtali and is considered to date that mine, why should not four Bantu skeletons found *in* ancient mines be taken equally as evidence ?

So far as space has hitherto allowed, I have put the plain facts of excavation on the table, these facts are now being dealt with fully in book form, which I hope may be available by the summer It is fair, therefore, that I, too, should be given facts, so that I may take them into full consideration Theory I have had offered to me, and generalisations without number But facts can only be met by facts Who will supply them ?

GERTRUDE CATON THOMPSON

Bedford College,
Regent's Park, N W 1,
Jan 15

Colours of Inorganic Salts

No satisfactory explanation of the colours of inorganic salts in the vapour state, in solution, or in crystalline form has yet been put forward, excepting certain suggestions by Fajans ("Handbuch der Physik", Bd 24, p 564), that the colours are due to the deformation of the cation produced by surrounding anions and molecular complexes The ideas of Fajans were rather vague, but the time has now come to put forward a more precise hypothesis It is well known that salts like NaCl, $CaCl_2$, $AlCl_3$, in which the electrons of the cation form closed shells (p^6), are colourless or white Herzfeld found from a study of dispersion of NaCl that there are three ultra violet absorption bands, one at λ340 which was ascribed to Na^+, another at about λ1500, which was ascribed to Cl^- ion This last one has been experimentally obtained by Pfund (*Phys Rev* vol 32) by the *Reststrahlen* method The wave length λ340 ascribed to Na^+ agrees remarkably well with the resonance line of Na^+ identified by K Majumdar (*Ind Jour Phys*, 1927) and Bowen, though definite assignment of values of the absorption wave length from dispersion data in this region is subject to certain uncertainties

Colours are almost entirely shown by the compounds of the transitional group of elements (the first group consisting of elements from scandium to copper) Let us fix our attention on the first group alone, as the same arguments will apply to other groups The colours are somewhat modified by the anion, or the state of aggregation (solution or crystal), but intrinsically it is due to the cation Taking a compound like $CrCl_3$, we can say that it consists of a Cr^{+++} ion, surrounded by three Cl^- ions The absorption of light in the visible region is due entirely to the outer electrons of the Cr^{+++} ion Let us see how this absorption takes place

The outermost shell of the Cr^{+++} ion (and generally of all ions of transitional elements) consists of a number of electrons in the d shell In Cr^{+++}, the number is 3 The multiplicity of the most stable combination state is obtained by adding up the multiplicity vector $r = \frac{1}{2}$ for all the electrons, and the next metastable states are obtained by reversing the vector r for one of the electrons In d^3, the states are respectively ^4X and ^2Y, where X and Y are further to be formulated This is obtained by considering the l coupling according to Pauli's principle, and in the case of Cr^{+++}, $X = F$ and P in ^4X, and $Y = H, G, D$ in ^2Y The average difference in energy between the terms obtained in this way, that is, by having the rotating quantum number all in one direction, and then reversing only one, is about Ca, = 20,000, the value increasing with the number of net charges in the nucleus, as shown by the spectroscopic data of Russell, Gibbs and White, Lang, Shenstone, etc (see various papers in the *Physical Review*)

It is therefore evident that the absorption of light in the visible region is due to some of the d electrons changing their r vector from $\frac{1}{2}$ to $-\frac{1}{2}$ This type of transition is possible only in transitional groups, and though usually forbidden they become very prominent in all molecular formations We cannot, of course, expect that the values of energy difference which we

obtain from spectroscopic studies will continue to hold good in molecules or complex formation, but they will remain of the same order of magnitude An indefiniteness will be introduced by the modification of the rules of l-coupling (*vide* Stoner's suggestive paper in the *Phil Mag*, September 1929, which explains D M Bose's hypothesis that it is only the rotating vector r which is responsible for the magnetism of the ions of transitional elements in a similar way)

There seems to be no experimental evidence in existence which can be utilised in support of the above hypothesis The absorption spectra of none of these compounds have been studied in the vapour state (the work of Franck and his school being confined mostly to the study of alkali halogenides) The emission spectra of some of these salts have been studied, but it is difficult to draw any conclusion from them Other interesting experiments may also be devised to test the above hypothesis Some of them are in progress

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Dec 27, 1929

The Heat of Dissociation of the Molecule O_4 and Sutherland's Constant for Oxygen

THE law of interaction of two colliding molecules follows the curve shown in Fig 1, where the mutual potential energy U of the molecules is plotted against the distance r between their nuclei In the case of molecules with saturated bonds, U is determined by the polarisation forces and repulsive forces, the nature of which we do not propose to discuss here When the chemical bonds are unsaturated, the 'chemical forces' (*Austauscheffekt*) also must be taken into account In both cases the energy minimum (U_0) corresponds to a definite stationary state of the

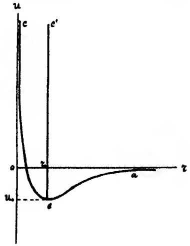

FIG 1

associated molecule Such a twin will appear if the molecules lose during the collision a certain amount of their energy, for example by means of a triple collision, so that the total energy attains a negative value The dissociation energy W of this twin is equal to $-U_0$ (Fig 1)

In the kinetic theory of gases, the molecules are regarded as perfectly elastic rigid balls, and the real curve *abc* is replaced accordingly by the curve *abc'* In this case the mutual energy of two molecules at the moment of collision must be equal to $-U_0$ We propose to show that this energy is nothing else than Sutherland's constant, which determines the dependence of the effective area of the molecule on the temperature

Owing to the polarisation forces, the effective area for the collision of molecules increases, as may be seen from Fig 2 The molecule 2, in the absence of

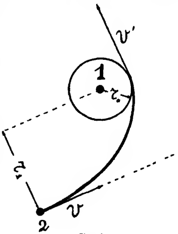

FIG 2

the attractive forces, would move in the direction of the dotted line without undergoing a collision with the molecule 1 But the attractive forces will draw the molecule away from the straight line path and a collision may occur The less the relative velocity of molecules 1 and 2, the greater will be the aim distance r_1, at which a collision still occurs Let us find now the connexion between r_1 and r_0 From the equations expressing the laws of conservation of energy and moment of momentum, namely,

$$\frac{mv^2}{2} = \frac{mv'^2}{2} - W \quad \text{and} \quad mvr_1 = mv'r_0,$$

where m is the effective mass of the molecules, v and v' are the relative velocities before and at the moment of collision respectively ($v'>v$), we obtain

$$\frac{mv^2}{2} = \frac{mv^2}{2}\left(\frac{r_1}{r_0}\right)^2 - W,$$

or, introducing real and effective target areas of the molecules (σ_0 and σ_1),

$$\sigma_1 = \sigma_0\left(1 + \frac{W}{mv^2/2}\right) \qquad (1)$$

This is valid for a single collision In order to calculate the mean value of σ_1 (for the gas as a whole) we must average the expression (1) We have

$$\frac{1}{mv^2/2} = \frac{2}{kT},$$

and therefore

$$\bar{\sigma}_1 = \sigma_0\left(1 + \frac{2W}{kT}\right) = \sigma_0\left(1 + \frac{2D}{RT}\right),$$

where D is the molar heat of dissociation Comparing this expression with Sutherland's formula,

$$\bar{\sigma}_1 = \sigma_0\left(1 + \frac{C}{T}\right),$$

we get

$$D = \frac{R}{2}C, \text{ or approximately}$$
$$D \simeq C \text{ cal} \qquad (2)$$

(The calculated ratio D/C depends on the way in which the averaging is done; see, for example, Condon and van Amunge, *Phil Mag*, **3**, 604; 1927. However, the order of magnitude of this ratio always remains the same.)

Unfortunately, the failure of the experimental data on the heats of dissociation of twin molecules and Sutherland's constant makes it impossible to prove the correlation (2) in many examples. The values of D and C simultaneously are known only in the case of oxygen. Thus, in order to explain the fact that the oxygen does not obey Curie's law, Lewis (*Jour Amer Chem Soc*, **46**, 2027; 1924) assumed that in liquid oxygen as well as in oxygen gas, the molecules O_2 are associated to some extent into O_4. Using data of Perrier and Kamerlingh Onnes for the magnetic susceptibility of oxygen at various temperatures, he estimated the molar heat of dissociation of O_4 into $2O_2$ to be about 128 cal (for liquid oxygen). There are some grounds for regarding this value as approximately correct for the gas. The existence of molecules of O_4 has also been suggested by Wulf (*Jour Amer Chem Soc*, **50**, 2596; 1928; *Proc Nat Acad Sci*, **14**, 609; 1928), on the ground of optical data, concerning the absorption spectra of liquid and gaseous oxygen. The identity of absorption spectra due to molecules of O_4 in the liquid and the gaseous states shows that the action of oxygen molecules does not produce any appreciable change in the energy levels of the molecule O_4. On account of this fact, we may suppose that the dissociation energy of O_4 cannot differ considerably in the liquid and gaseous states. For Sutherland's constant for oxygen, different authors give values varying from 127 to 138. These figures are very near to that obtained by Lewis for D. Further experiments will show whether it is a mere coincidence or not.

Experimental work on this problem is in progress in the laboratory of Prof N N Semenoff in this institute. In conclusion, we wish to extend our thanks to Prof J Frenkel for his kind advice.

S Bressler
V Kondratjew

Physical Technical Institute,
Leningrad, Nov 15

The 'Common Third Level' in the Raman Effect

In recent communications to Nature, Langer and Dieke have pointed out that generally the shifts observed in the Raman spectra correspond not directly to the absorption frequencies of the scattering substance but to *differences between its absorption frequencies*, and that this is in accordance with the dispersion theory of Kramers, Heisenberg and Schrödinger. As a consequence of the quantum dispersion theory, the probability that we should observe a shift of Raman lines corresponding to the transition $E_i \to E_k$ is dependent on the probabilities of the transitions from $E_i \to E_n$ and from $E_k \to E_n$ where E_n is any third common level. The purpose of this note is to point out the significance of the common level from a physical point of view.

In the case of scattering of light by free electrons Pauli (further extended by Einstein and Ehrenfest) (*Zeits für Phys*, Band 18 and 19) showed that the probability of scattering of light of frequency ν', when the incident light has the frequency ν, is $\alpha\rho_\nu + \beta\rho_\nu\rho_{\nu'}$. From the classical point of view, scattering is really made up of two processes taking place simultaneously, namely, (1) absorption, (2) re-emission. Hence, even in cases when the frequencies of the incident and scattered light are different—that is, the scattering is not classical—we should expect, from the general ideas of correspondence between classical and quantum concepts, that the mechanism of the process should still be essentially the same as it will be in the limiting classical case. In all cases of scattering, two processes must always take place, (1) absorption and (2) emission. The probability of (1) from the point of view of Einstein is $B_{12}\rho_\nu$, and of (2) $A_{21} + B_{21}\rho_{\nu'}$, and hence the probability of scattering of ν' is $= \alpha\rho_\nu + \beta\rho_\nu\rho_{\nu'}$, where $\nu = E_2 - E_1$, $\nu' = E_2 - E_1$.

These considerations can now be applied to the Raman effect.

Let us consider scattering from a molecule possessing only two levels E_i and E_k. When light of frequency ν is incident and is then scattered, the two processes which take place are

(1) Absorption—the molecule passes from $E_i \to E_k$,
(2) Re-emission—the molecule passes from $E_k \to E_i$,

and thus, on the whole, the molecule neither takes nor gives anything to the incident quantum, and so the frequency of the scattered light remains ν. If a molecule has only two levels, it cannot give rise to combination (Raman) scattering.

If there be a third common level E_n, the molecule during the processes

(1) may pass from $E_i \to E_n$,
(2) may return from $E_n \to E_i$ or $E_n \to E_k$,

giving rise to the unmodified and the modified lines.

Combination scattering (Raman effect) is, therefore, entirely dependent upon the existence of a third level, and this view also enables us to calculate the intensity of the modified lines.

Kramers and Heisenberg in their original paper discussed the possibility of another allied effect which is theoretically as important as the Raman effect, but has not yet been observed. Generally ν_{ik} is much $<< \nu$, but if $\nu_{ik} > \nu$, as we should expect only in electronic transitions, then when the molecules are illuminated by light of frequency ν, it should excite in the scattered radiation light of frequency ν and $\nu_{ik} - \nu$. A molecule in the excited state k, when subjected to the field of frequency ν, is forced to emit radiation ν. To do this the molecule should revert from the state ν_k to the normal state ν_i, and the balance of energy $\nu_{ki} - \nu$ will appear as another quantum. It can be easily seen that the experimental verification of this prediction will be much more difficult than that of the Raman effect, as we must have a sufficiently large number of molecules in the much largely energy richer state ν_k.

We may be permitted to mention that the possibility of such an effect was discussed in the local Science Colloquium on Nov 22, 1929, but we did not publish our views in the hope of gaining some experimental verification. The same view has been expressed by Göppert in a recent note in *Die Naturwissenschaft* (Nov 29, 1929), but no experimental verification has yet been obtained.

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D S Kothari

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Dec 17, 1929

The Fallacious Determination of the Specific Heats of Gases by the Explosion Method

The recent gales suggest how fortunate a thing it is that the rate of motion of gas in an equilibration of pressure is not that of sound, which is of the order of 740 miles per hour. The phrase, common among students of gas explosion phenomena, that 'pressure equilibrium is attained at the speed of sound' has, indeed, on analysis, no meaning whatever; the rate at which gas moves over a point is a function of the pressure gradient at that point.

Since the 'eighties, many attempts have been made to determine the specific heats (C_v) of gases by measuring the maximum pressure reached in an explosion of such a mixture that the gas in question is one of the residual gases Such determinations are fallacious, for when the experimenter has taken the elementary precaution (foreshadowed by Mallard and Le Chatelier) of using a sphere, with central ignition, so that at the moment of maximum pressure all the gas has suffered the passage of flame—a consideration which also dictates the use of a mixture through which flame passes so quickly that buoyancy may be neglected—there is still the difficulty, stated by Sir Dugald Clerk, that the combustion is not then complete

This incompleteness is not mainly a surface phenomenon, the effect of which would be small and eliminated by the use of different vessels Ellis and Wheeler have shown that the combustion is most nearly complete in the gas which suffers the passage of flame in the later stages of the inflammation, when the pressure is high, and that the combustion of the gas ignited earlier continues for some time after the moment of maximum pressure—it may be for a period many times as long as that taken by the flame to spread through the vessel

This result may be shown independently, as follows Inflammation of the mixture is achieved gradually in successive portions by a continuous ignition, shell by shell, each shell at an initial pressure a little higher than that of its predecessor, and each shell over a greater surface than its predecessor's As each successive portion of the gas mixture is thus inflamed, it expands, thus making its own contribution to the increasing pressure, which is entirely derived from this continuous succession of local expansions On the face of it, one should be very chary of assuming either that the work it lends the system, by its temporary expansion, is necessarily fully repaid again by subsequent compression to initial volume before the moment of maximum pressure, when the last shell of gas is inflamed, or that inflammation when the pressure is low follows the same chemical regime and reaches the same chemical goal as when it is high

To recognise a continuous succession of local expansions is to recognise in the flame surface a watershed source of continuous pressure generation a pressure gradient, accompanied by an equilibrating surge, extends inwards towards the centre, and a second pressure gradient, accompanied by an equilibrating surge, extends outwards to the wall We are concerned in this letter chiefly with the state of affairs at the moment of maximum pressure, when the last shell of gas becomes flame It is evident that the inward gradient and the inward equilibrating surge must now extend from the wall to the centre The speed of this surge, which is the immediate agency by which the inner gases are recompressed toward their initial volume, has, from its inception, been increasingly affected by the chemical action which it has continuously and increasingly induced in the gases suffering this recompression, its speed now begins to be affected also by the contraction of gases in its rear as they lose heat by conduction to the wall of the vessel This surge must spend itself before the output of energy from the inner gases can be regarded as having ceased

As corollaries, it may be noted that the inmost portions of the gas are never subjected to a pressure quite so high as that reached by the outermost and registered at the moment of maximum pressure by the manometer at the wall, also that these portions are never recompressed quite to their initial volume if they finally reach it, it is by cooling

When the vessel is not spherical, the inward surge may be faster or slower according to the shape of the vessel and the incidence of the cooling losses An interesting snapshot photograph of such a surge may be consulted in *Fuel*, 410 (1928)

Summarising, the constitution of the gas in an explosion at the moment of maximum pressure is not known, but it is impossible that it is homogeneous, or that the combustion ceases before sensible cooling has supervened

OLIVER C DE C ELLIS
Safety in Mines Research Board's Laboratories,
Sheffield, Jan 11

Reversibility of Evolution

I HAVE read with deep interest the report of the lecture by my old friend, Prof H Fairfield Osborn, on "Tertiary Man", published in NATURE of Jan 11 In this lecture Prof Osborn stresses very strongly Dollo's principle of the irreversibility of evolution, that is, the doctrine that once a structure has been lost by an animal through disuse, even if changed circumstances should again make it useful it cannot be revived

Whilst accepting this principle as applying to the majority of cases, there are certain exceptions to it which put us on our guard against asserting it unconditionally One of these—particularly clear—I should like to refer to here The original dermal armature of the craniate vertebrate appears to have consisted of small teeth embedded in the skin such as are retained to day in the placoid scales of sharks and rays As time went on the bases of groups of these teeth became bound together by an ossification of the connective tissue beneath them, and so the bony scale, still found in the archaic 'ganoid' fish, *Polypterus* and *Lepidosteus*, was produced On the surface of these scales minute microscopic teeth can be detected Later, as the earlier Mesozoic fish developed into the first true Teleostei of the Cretaceous period, not only these teeth but also the bony layer disappeared, and the scale became a mere horny film as it is in the majority of fish to day

Some time in the earlier Eocene these herring like early Teleostei threw off a fresh water branch, the Siluroids or catfish The typical catfish has lost the scales altogether, but some South American forms which inhabit torrential streams, possibly owing to the habit of pressing their bodies closely against the bottom, have redeveloped bony plates in the skin, and, in some genera, on the surface of these plates *small dermal teeth in all respects identical in structure with the placoid scales of sharks*

I remember well when this extraordinary fact was demonstrated to me by my friend and fellow student, Pollard, of Christ Church, Oxford, when we sat side by side in Naples in 1892 It was fully described by Hertwig and was well known at the time

I respectfully ask Prof Osborn to estimate how many million years intervened between the time that the ancestors of Siluroids lost their teeth and the time when their descendants redeveloped them

We must admit, therefore, that even after an organ has ceased to appear in the normal development of a creature, the power to produce it still remains for an indefinite but varying time embedded in the organisation of the animal and can be revived if the appropriate circumstances recur

This power may be aptly compared to habitudinal memory, and its calling into action resembles the revival of a half forgotten habit

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Tertiary Man

In Prof Fairfield Osborn's address on "The Discovery of Tertiary Man" (Nature, Jan 11, p 55), it is stated, in regard to the discoveries I have made in East Anglia, that Prof Breuil "shifts the entire pre Chellean and Chellean flint industries from mid-Quaternary down into the base of Quaternary time, namely, into the first Interglacial or Mindel-Riss stage" The first inter glacial is, however, that of the *Gunz Mindel*—according to the Penckian scheme—and it is to this phase—represented in East Anglia by the Cromer Forest Bed—that Breuil now relegates the Chellean industry Prof Osborn had no doubt in mind Breuil's recently published list of his scientific papers when writing the address referred to, as in this list the impression is given, no doubt unintentionally, that the author was the first to refer the Chellean implements to the first inter glacial epoch This impression is, however, incorrect, as no less than ten years ago, in 1920, I published a note in the *Geological Magazine* (vol 57, No 671, May 1920, pp 221 224), in which, with much detail, I set forth my views on the relationship of palæolithic man to the glacial period, and stated (p 223) that "The Chellean implements may therefore be of *Gunz Mindel* inter glacial age" When I made this announcement, to which I have adhered with ever increasing conviction, few, if any, archæologists agreed with my opinion, and it was only after several visits of Prof Breuil to East Anglia that he was convinced of its truth

J Reid Moir

Entomophagous Parasites and Phagocytes

In his interesting letter in Nature of Jan 4 on the parasites of the pine shoot moth, *Evetria buoliana* Schiff, Mr C C Brooks gives some figures which seem to indicate a correlation between the percentage of parasitism and the size of the emerging moths, and advances the view that the diminution in size, which he has observed in moths from areas in which the parasitism is high, is due to the fact that some of the parasitised larvæ have recovered from the parasitic attack, so that the adult is able to emerge, although it shows the effect of the feeding of the parasites in its unusually small size

It is not uncommon to find in caterpillars or pupæ the remains of dead parasites, but so far as I have observed, this is rather rare in cases where the parasitic larvæ have reached a stage so advanced as those mentioned by Mr Brooks His suggestion is, therefore, a highly interesting one, and it is to be hoped that he will be able to verify it by dissections

My object in making these comments is not, however, to discuss the hypothesis put forward by Mr Brooks, I simply wish to make a few remarks in regard to the view he has expressed concerning the process of recovery from parasitism, and more especially the part played by phagocytes in cases of this kind

The evidence in favour of the views advanced by Mr Brooks is, on the whole, very unsatisfactory What the data actually indicate is that the part played by phagocytes in relation to insect parasites is of very little importance Metchnikoff, the founder of the phagocytic theory of immunity, long ago pointed out in his "Lectures on the Pathology of Inflammation", that the phagocytic reaction of Arthropods is, in general, very feeble

In his excellent work on the biology of the parasitic Diptera, J Pantel (*La Cellule*, 26, 1er fasc, 1910), whose conclusions were based on the study of a large number of species, states that as a general rule the free and healthy larvæ of entomophagous insects are not attacked by phagocytes

My own conclusions, based upon the dissection of thousands of individuals of insects belonging to practically all orders, and infested by entomophagous parasites of many groups, agree perfectly with those of Pantel Healthy parasites, no matter in what stage of the host they are found, are practically never surrounded by phagocytes, provided they lie free within the body cavity of the host There is no particular reason for believing that the parasite larvæ repel the phagocytes In sections of parasitised hosts the blood cells seem to be just as numerous in the vicinity of the parasite larvæ as they are in other parts of the body They are simply indifferent to the parasites, as they are to the organs of the host itself On the other hand, if a parasite has an anatomical relation with the host, of such nature that destruction of tissue is produced, a considerable accumulation of phagocytes may occur around the point of the lesion The extent to which phagocytes accumulate is variable and appears to depend in part upon the specific nature of the host, and in part upon its general condition On the other hand, an accumulation of phagocytes does not appear to exert any effect whatever on the healthy parasites

A brief summary of the results obtained by me up to that time was published in 1915 (*Bull Soc Zoologique de France*, 40, pp 63 68) A detailed account is now in course of preparation

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Scattering of α-Particles by Light Atoms

In a recent discussion at the Royal Society (Nature, vol 123, p 246), Sir Ernest Rutherford pointed out the great importance of the experiments on the scattering of α particles by light atoms like those of magnesium, aluminium, helium, and hydrogen which are being carried out at the Cavendish Laboratory by himself and his co workers Bieler, Chadwick, and others The results of these experiments show very wide variation from the classical expression obtained on the assumption of an inverse square law, and led Rutherford and Bieler to the view that the repulsive force between positively charged particles changes into an attractive one when the distance of approach is less than 3×10^{-13} cm Many attempts have been made to get an exact expression for this force Bieler thought the force to be given by the law $F = \frac{Ze^2}{r} - \frac{\mu}{r^4}$, while Debye and Hardemeier took the additive term to be inversely proportional to the fifth power of the distance

While the exact form of the law will probably take some time to discover and will probably be given by some developments in the generalised theory of relativity, it is profitable to see how far the assumptions of these additional forces can be justified from the point of view of wave mechanics Born has given a general way of treating collision problems on wave mechanics, and Wentzel, Sommerfeld, and Mitchell have deduced, by the use of Born's method, Rutherford's classical expression for the scattering of α particles I have tried to explain abnormal scattering of α-particles by light atoms from wave mechanics by using the law $F = \frac{Ze^2}{r^2} - \frac{\mu}{r^n}$ It appears that the equations can be solved by the polynomial method only when $n = 3$ Using this value of n, I have deduced an expression for scattering which is in very good agreement with the results obtained in the Cavendish laboratory

The assumption of the same law in Schrödinger's

equation enables us to calculate the 'Eigenwerte' of α-particles in the nucleus Discrete positive as well as negative 'Eigenwerte' are obtained, according to initial conditions assumed The positive 'Eigenwerte' are very interesting, because with certain further assumption they are capable of explaining the γ rays of the six radioactive elements which have been so far accurately measured The numerical agreement is very remarkable

The complete papers will be published in the *Philosophical Magazine*

A C Banerji
Mathematics Department,
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Dec 11, 1929

Nitrifying Bacteria

During the course of investigations on nitrification in soil and in a sugar beet effluent filter bed, several different bacterial strains have been isolated capable of oxidising various ammonium salts to nitrite, as shown by the Griess Ilosva method This is interesting because it has usually been assumed that nitrite formation was brought about by the varieties of bacteria known as *Nitrosomonas* and *Nitrosococcus* first isolated by Winogradsky in 1891 There are, however, scattered references in the literature to other organisms capable of producing nitrite from ammonia, but unfortunately the diagnostic characters given are insufficient for sure identification Among the well known characteristics of Winogradsky's organisms are the following inability to grow on nutrient agar or gelatine, inhibiting effect of organic compounds such as sugar, optimum growth at pH of 7 7 – 7 9 In contrast to these the organisms isolated in this laboratory grow well and rapidly on both nutrient agar and gelatine (in the case of the soil forms Winogradsky's medium is unsuitable), the presence of 0 1 per cent sucrose in no way inhibits growth, and in the soil forms definitely stimulates nitrite production Nitrite formation takes place at a wide range of pH values varying from 4 5 to 7 9

Further, morphologically, the varieties of *Nitrosomonas* and *Nitrosococcus* on the whole do not resemble the soil and effluent forms isolated here

This new group of organisms has up to the present been shown to produce nitrite when grown in a culture solution of the following percentage composition 0 06 sodium chloride, 0 002 calcium chloride, 0 0005 magnesium sulphate, 0 03 potassium acid phosphate, 0·1 sucrose, the only sources of nitrogen being one of the following ammonium salts, sulphate, phosphate, carbonate, chloride, lactate, or acetate Some of the strains produce nitrite from all the ammonium salts tested, while others will only produce it from certain of them On the whole, the organisms isolated from the effluent produce nitrite more freely from ammonium lactate and the soil forms from ammonium phosphate

A full description of these bacteria, together with their physiological reactions, is in the course of preparation

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The Life-Cycle of *Bac saccharobutyricus* v Klecki

In 1927, Cunningham and Jenkins (*Jour Agric Sci*, Vol 17, pp 109 117) showed that under certain conditions the motile butyric acid bacillus is capable of producing aerobic micrococci Studies of this organism continued during the intervening period of three years have demonstrated that it passes through a life cycle in which at least seven distinct cell types can be distinguished—forms similar to the (1) coccoid, (2) short rod, (3) slender rod, (4) large rod, (5) dwarfed growth, (6) fungoid, and (7) large cell types of Löhnis and Smith Of these, representatives of types 1 to 4 have been stabilised and the majority have been identified with previously described 'species'

The cocci consist of white, orange, and red forms corresponding to *M candicans* Flugge, *M aurantiacus* Cohn, and *M roseus* (Bumm) L et N The short rods are represented by unidentified white and red types The more important of the slender rods are *B putrificus* Bienstock, *B sporogenes*, Metchnikoff, *B putrificus* Reddish and Rettger, *B circulans* Jordan, *Pectinobacter amylophilum* Makrinov, and *B Globigii* Migula, while the large rods are represented by *B Ellenbachensis* Stutzer and *B sphæricus* A M et Neide

Formation and germination of endospores, exospores and microcysts have been observed as well as formation of gonidangia, gonidia, and regenerative bodies Observations have also been made on the formation of, and regeneration from, the symplasm, and on conjunction with formation of regenerative bodies at the points of contact of the cells When cultures of the slender rod type produce terminal regenerative bodies they have been found to be capable of decomposing cellulose under anaerobic conditions A detailed account of the results of the investigation will be published elsewhere

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Regeneration of the Spines in Sea-Urchins

In Nature of Nov 16, p 760, Mr H C Chadwick records a case of regeneration of the spines in *Echinus esculentus* While working at the Marine Laboratory, Plymouth, last summer, I noticed a number of specimens of *Psammechinus miliaris* behaving in a similar way The individuals belonged to a small, deep water race obtained from about 15 fathoms near the Eddystone On July 25 about thirty specimens were placed in a bowl under circulation and kept in darkness A similar number were exposed to direct sunlight The former lot remained healthy and underwent no change About half of the lot kept in the light threw off all their spines except those on the oral surface, which were unaffected A week afterwards a fresh crop of minute spines began to appear These grew so rapidly that in two months the majority of these individuals could scarcely be distinguished from those which had not thrown off their spines

It may be noted that Dr Mortensen states in his "Handbook of the Echinoderms of the British Isles" (1927, pp 262 263) that in sea urchins "The power of regeneration is great, spines and the other external organs are easily regenerated Autotomy is not known to occur in the Echinoids"

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Ruthenium a Superconductor

In some experiments recently made in collaboration with J F Allen and J O Wilhelm, we found ruthenium became superconducting at 2 04° K The metal was supposedly of high purity, but retained its high resistance down to nearly 4° K

J C McLennan.

The Great Telescopes of the Future[1]

FOR some ten years past visitors to the Observatory of Paris have found Dr Ritchey installed on the top floor, working out his optical ideas. These ideas are the fruit of his long experience in the use and construction of telescopes, first at Yerkes and later at Mount Wilson. They are thus very mature, and unless we are to discard experience altogether, they deserve the most careful consideration.

The publication before us has been distributed by the great glass making firm of St Gobain. M Delloye, the manager, to whom Dr Ritchey pays many grateful acknowledgments, states that it arose from the wide interest excited by a presentation in Paris, by the Company, of Dr Ritchey's celestial photographs. Accordingly, to make the presentation permanent, the company has issued half-tone reproductions of nineteen of the finest photographs, together with several others illustrating Dr Ritchey's experience and projects. Most of the pictures are included in the excellent series of astronomical photographs which are available through the Royal Astronomical Society, and one gets the impression that they are familiar by their incorporation in various popular books. A careful scrutiny, however, shows that the present publication leaves far behind the best that has been produced before, and in that connexion it is germane to recall that *all* the best photographs of stellar and nebular fields were made by Ritchey, and the most sensational of them were made by telescopes the chief parts of which, both optical and mechanical, he had made, and in many cases had devised also. On revision of that sentence one may add Barnard's name, but no other. This should not be forgotten in considering the outlook for the future.

The text of this brochure has been written in English, and translated into French, somewhat carelessly. Both versions appear side by side. In no case is the French an improvement upon the author's careful wording. In one case the French text achieves the exact opposite of the English, as when "Nous avancerous ainsi lentement, mais sûrement" does duty for "We shall thus advance by *long, sure* steps". What is of interest, in addition to these epoch making photographs, is an outline of Ritchey's view of the right construction for the great telescopes of the future. Those who wish for a fuller account of the same will find it in the *Transactions of the Optical Society*, **29**, p 197 (1928)—the Thomas Young Oration—where details, numbers, and references, here lacking, are given.

It is evident from this publication that Ritchey is still ardent and unwearied in the pursuit of more, and still more, perfect and powerful optical means. That may seem an obvious thing to say. But improvements of means demand an ever stricter discipline in their use, and there is a good deal to be advanced for getting full service out of the instruments we possess. It is possible to spend so much time in preparation that nothing is left for achievement. But let that be the consolation of those who must be content with something less than the best. It is evident that if we are to penetrate further into space—and the remote, small objects are at least as significant as those we happen to be near—we must have greater power. Now few look for a greater refractor than about 40 inches. Even the 100 inch reflector is not likely to be surpassed without change of plan. But as readers of NATURE know from an article in the issue of Dec 21, 1929, the California Institute of Technology has been furnished with the funds for a reflector of 200 inches, and the plans are already energetically advanced, by Dr G E Hale, assisted by investigators of every type. In the conduct of these investigations no door has been closed in advance, and any location and any type of telescope may be adopted. But so far as they go, they seem to point to a repetition of the 100 inch as to mounting, and as to the mirror, a solid disc of fused silica, faced with fused quartz. The total weight of the moving parts is estimated at 500 tons. To intensify the light gathering the focal ratio is to be unusually short, 3 3, and is to be shortened still further by an interposed lens which is also to correct the field for coma.

Everything depends upon a right choice, but it is scarcely the place of those outside the scheme to follow the decisions that must be made with anything except hearty good wishes for their success.

The design of a super telescope to which Dr Ritchey has been led, and which he has gradually developed, but varied very little, in a lifetime of study, is quite different, and in many ways it is bolder in its novelties. First of all he would not have a solid mirror, which for the 200 inch size must weigh 30 tons. He could build it up of a back- and a face plate, separated by a honeycomb structure, also built of thin plates of the same composition. Weight could be reduced to one quarter, support could be made by flotation, or at the centre of gravity, air could be circulated throughout. A reduction in the weight of the mirror permits a proportionate reduction elsewhere. Intensification of light gathering and correction for coma would be produced by 'figuring' from a Cassegrain model, on a plan devised by Prof Chrétién and himself. The telescope building would be in the form of a tower, at the top of which would be a dome containing two flat mirrors of which one only rotated in the ideally simple cœlostat manner, and sent a vertical beam through the centre of the tower to the great mirror which lay fixed in a horizontal position. This construction permits immediate change of the secondary mirrors, thus multiplying the uses of the telescope. Not unimportant, the observer would also be in an easy position. There are many other details of technical interest, but they must be passed over here.

It is again scarcely useful to express or to form an opinion upon these proposals. What is impracticable to one pair of hands, may be perfectly successful in another. Most seems to depend upon the

[1] L'Évolution de l astrophotographie et les grands télescopes de l avenir (The Development of Astro photography and the Great Telescopes of the Future). Par G W Ritchey. Publié sous les auspices de la Société Astronomique de France. Pp 36+34 planches. (Paris.)

success of the built up mirror Cemented glass is usually reckoned a tricky construction, with a horrible aptitude for flying and tearing flakes off the face it is cemented to As against this, Dr Ritchey in 1911 and 1912 made two flats in this way, 20 inches in diameter, and they have since behaved beyond reproach He figures in these publications the honeycomb part of a 60-inch mirror, and also a more advanced stage, but it does not appear to have ever been completed If it is a question of funds, I submit that it would be well worth the while of those interested in the major problem, to see that that experiment, which has been carried so far, is tried out and not left inconclusive R A S

Denudation in the Punjab Hills

THE denudation of mountain slopes, as a result of the ignorant clearance of forest under the combined activities of the lumberman, fire, and excessive grazing, and the resultant damage is not a new problem and has been previously referred to in NATURE For centuries the Alps have furnished examples of the difficulties which governments have to contend with in combating the ignorance of the local population on the subject of the actual causes from which the trouble arises Throughout the Mediterranean, large areas of bare hills form an object lesson of the same kind, whilst America provides the most recent examples of the inevitable results following wholesale destruction of the vegetation in hill and mountain areas through excessive logging, often followed by extensive fires, and over grazing A recent paper on "Denudation of the Punjab Hills" (*Ind For Records, Sylv Series*, vol 14, pt 2, 1929), by Mr B O Coventry, traces the history of denudation and its results in the province Mr Coventry is a conservator of forests and has been in the province since 1895 His treatment of this important matter and the conclusions he has arrived at merit careful attention

The monograph commences with a consideration of the forest vegetation and evidence of denudation The main topographical tracts are distinguished as (1) The Himalayan tract, (2) The Sub Himalayan tract, comprising the lower hills up to about 3000 ft and including the Salt Range on the west and the Siwaliks on the east, two outlying ranges of hills rising from the plains to about 3000 ft, (3) The Plains

The climate in these regions varies considerably, the rainfall being about 30 in per annum near the foot of the hills to 5 in or less in the south of the Plains Mr Coventry, in considering the denudation problem, divides the climatic or forest zones as follows (1) *Plains*—Tropical zone (below 1000 ft), zone of *Prosopis spicigera* (2) *Sub-Himalaya*—Sub Tropical Zone (1000 ft to 3500 ft), zone of *Acacia modesta* (forests in east differ from those in west) (3) *Himalaya*—(a) Sub-Temperate Zone (3500 ft to 5500 ft), zone of *Pinus longifolia*, (b) Lower Temperate Zone (5500 ft to 7500 ft), zone of *Pinus excelsa*, Upper Temperate Zone (7500 ft to 9500 ft), zone of *Abies Pindrow*, Sub-Alpine Zone (9500 ft to 12,000 ft), zone of *Betula utilis*, Alpine Zone (above 12,000 ft), no tree growth

It will be understood, as is invariably the case in mountainous regions, that aspect, exposure, and latitude modify the appearance of a species in a locality, and there is no clearly marked line of demarcation between two adjacent climatic zones though these are separated by what may be regarded as a 'neutral zone' where species of the two zones flourish equally well Moreover, each of the above forest zones is not occupied by one type of forest alone, but different kinds of forest occur in the same zone, and the factors determining the distribution of the types are edaphic or soil factors The species which will regenerate on dry soils are termed 'xerophytes', and those which require moist soils 'mesophytes' These terms become important when it is considered that whereas a seedling may find the requisite soil conditions to enable it to become a well established tree, its root system then going deep down in the soil, subsequent denudation may remove all the surface soil, thus preventing further seedlings developing on the area Owing to this fact, as the author points out, and to the great age to which some species live, "it is not uncommon to find a forest of a particular species growing on a soil" or even on bare rock "which is quite different from the kind of soil it requires for its natural regeneration or upon which its distribution is dependent" A change from a xerophytes type of vegetation to a mesophytes type in the series is regarded as a case of 'progression', whilst the contrary is looked upon as a case of 'retrogression' One part of Mr Coventry's observations has been devoted to a study of the 'retrogressive' changes in the vegetation of the Punjab Hills After discussing the forest vegetation in the different forest zones (for which the reader is referred to the monograph) the retrogressive changes in the different zones are summarised as follows

The forests in each zone are generally undergoing retrogression In the Sub Tropical zone the climax formations of olive (*Olea cuspidata*) forests and other mesophytic types are changing to brushwood forests of *sanatha* (*Dodonaea viscosa*) In the Sub Temperate zone the mesophytic and climax formations of oak are changing to *chir* pine (*P longifolia*), and the *chir* pine forests are generally deteriorating in quality In the Temperate zone climax formations of oak or other broad leaved species are changing to blue pine (*P excelsa*) In other words there is a general tendency for the climax and mesophytic types to change to more xerophytic types indicating a general change from moist to drier soil conditions Although these conclusions have been arrived at from observations with regard to the vegetation chiefly on the Murree and Kahuta hills, they apply

more or less equally to the vegetation on the hills throughout the Punjab, including the Indian States of Kashmir, Chamba, Poonch, etc

Evidence of denudation is then considered, and everyone having acquaintance with the Province will appreciate the truth of the following description

A considerable proportion of the hills of the Punjab, exclusive of areas under cultivation, are bare of forest vegetation, especially in the lower zones, but it is evident from a study of the forest vegetation of the neighbouring wooded hills, and even to the most casual observor, that these bare hills were previously densely wooded everywhere within the limits of tree growth and at no very remote date There is evidence in some localities of hills having become denuded of their forest vegetation within comparatively recent years, and the older inhabitants of many of the villages can give instances where hills have become more or less denuded within their lifetimes Considerable areas of village forest lands which were known to be well wooded at the time when the Forest Settlements were drawn up about forty to fifty years ago, have since been more or less completely denuded of their vegetation, especially in the lower hills Some of the villages now experience considerable difficulty in obtaining sufficient timber and firewood or fodder, whereas formerly they had ample supplies available There is evidence in old historical records of hills which are now in a denuded condition being previously densely wooded For instance, in the Gazetteer of the Kangra District there is an interesting account taken from old records of the conquest of Mau and Nurpur under Shah Jehan about 300 years ago, in which reference is made to the 'impenetrability of the jungles' at that time, but these jungles are no longer existent Again some of the old Atlas sheets prepared from surveys made 60 70 years ago show tracts of low hills as densely wooded, which are now in a denuded condition

Although there is ample evidence of great denudation having taken place in the past, the retrogressive changes accompanied by erosion of the surface soil which have been shown above to be taking place in the existing forests is evidence that denudation is still actively in progress at the present day, and it requires little imagination to foresee that if this steady process of denudation continues unchecked the hills of the Punjab must sooner or later become more or less completely denuded of soil and vegetation and reduced to a desiccated condition

As to the causes, Mr Coventry dismisses the theory that there has been any change of climate responsible for the desiccation, remarking that there are living trees in existence of olive, oak, and deodar which cannot be less than a thousand years in age, and these species still regenerate and grow vigorously in the same localities provided the conditions of soil are suitable In common with a number of other authorities, he allocates the blame for the present state of the hills upon man, (and not climate), to whom the retrogressive changes in the vegetation are due, the changes being traceable to changes in the soil following erosion

If, however, the erosion of the surface soil is simply to be regarded as the normal result of disintegration and gravity and has always been in progress to the extent to which it is taking place at the present day, it becomes impossible to explain how the hills ever became clothed with forest vegetation, and especially with the climax formations on deep deposits of humus soil This can only have taken place when there was a condition of more or less equilibrium, that is to say when soil was accumulating as rapidly as, or more rapidly than, it was being eroded away, and it seems evident, therefore, that some factor has come into play which has upset this previous condition of equilibrium, resulting in erosion of the surface soil, which is gradually denuding the hills of soil and vegetation All the evidence which is forthcoming shows very conclusively that this factor is man, by means of fires and grazing of his cattle

Outside the broad leaved type, when not opened out, the only type of forests which are resistant to fire are the Chir pine forests These have been burnt periodically from remote times The persistence of the tree is due to its thick bark But each time the forests are fired a certain amount of soil erosion follows, and eventually the forest degenerates into scattered stunted trees standing on more or less bare rock, of which there is an excellent illustration in the monograph Next to fire comes grazing of the large flocks which the hill people keep, exceedingly poorly bred and of little value The trouble during the past fifty years has been due to the almost unlimited recognition by the old Settlement officers of the peoples' rights to graze the flocks over large areas of the hills With the impoverishment of the forests and increasing denudation, grass and browsing materials greatly decreased and the people took to lopping the trees In the Report of the recent Royal Commission on Agriculture in India (1928) it was remarked that no complaints as to serious damage being done by lopping of trees were received There are, however, plenty of instances in the North West Himalaya, the practice is a most serious factor in the work of denudation

It is unnecessary to follow the author into his treatment of the effects of denudation—floods, water supplies, and irrigation, and so forth As regards remedial measures he prescribes the introduction of an organised pasture management He does not appear to be acquainted with the methods found in France, where areas of pasture are managed in conjunction with rougher grazing and timber forest (from which animals are excluded) The whole area may be communal or village owned—but is managed under the supervision of the Forest Department This system of management is on the lines Mr Coventry advocates, but in France it is established

In the Punjab the Government is faced with the difficult work of afforesting the denuded areas This will demand high skill and sufficient funds But that the matter is urgent Mr Coventry's monograph well displays Others have stressed the same warning The fate and future of the great irrigation schemes in the Punjab plains are directly dependent upon the preservation of the water supplies in the hills and the prevention of further denudation and the arrest of what is taking place Government has already had warnings by means of bad floods in the past

Last year flooding and wholesale damage were on a terrible scale, and it may be hoped that the appearance of Mr Coventry's brochure may pave the way to a better understanding of this serious problem

The monograph may also be commended to the Colonial Office and its officials For there are many other parts of the British Empire where the same conditions as Mr Coventry describes in the Punjab Hills are being produced and by the same agencies It forms one of the large and pressing problems of the day in such regions

Obituary.

Dr Sebastian Z de Ferranti, F R S

SEBASTIAN ZIANI DE FERRANTI was born in Liverpool on April 9, 1864, and was educated at Hampstead School, St Augustine's College, Ramsgate, and at University College, London Even from his earliest days he showed a great bent towards engineering invention, and before he left school he began to build a dynamo When he was only seventeen years of age the first Ferranti machine with its coreless disc armature was installed in the arches under Cannon Street Station In the year 1882 he and Mr Francis Ince went to Glasgow to interview Sir William Thomson (Lord Kelvin) to try to arrange a working agreement with him, as it was found that one of Thomson's patents partly anticipated Ferranti's invention An agreement was arrived at, but it placed rather too heavy a burden on their manufacture In 1883 the firm of S Z de Ferranti and Co, the forerunner of the large works at Hollinwood, Manchester, was established at Charterhouse Square I remember going over this factory so long ago as 1890 and being greatly impressed by seeing hundreds of Ferranti meters all connected in series being tested

In 1883 the late Lord Crawford and Sir Coutts Lindsay decided to adopt electric lighting at the Grosvenor Gallery in Bond Street They installed a small plant, but the urgent requests of neighbours led them to enlarge it, and Ferranti was put in charge He planned 2500 volt overhead conductors and underground mains, and supplied an area extending from Regent's Park to Charing Cross and from Lincoln's Inn Fields to Albert Gate This was a marvellous feat for that period, but Ferranti's magnetic personality attracted an enthusiastic band of assistants, to whom he used to attribute much of his success He was soon convinced, however, that Bond Street was not a suitable site for a power station He saw that in order to supply electricity economically it was necessary to build a large generating station in a place to which coal could be conveyed cheaply, where rents were low, and where abundant water could be had for the boilers and condensers He visualised that to light London it would be necessary to obtain a site in the suburbs near the river and to transmit electricity to substations at the high pressure of 10,000 volts The site he selected was at Deptford, some eight miles from the centre of the load, and there he built a great power station, having machinery of more than 40,000 horse power and generating at 2300 volts The pressure was then raised to 10,000 volts and transmitted to the substations The scheme was taken up enthusiastically by Francis Ince, Lord Crawford, Lord Wantage, and others, and the London Electric Supply Corporation, Ltd, was founded

With practically no previous experience to guide him, as this was the first high tension station in the world, Ferranti designed by himself generators, transformers, mains, and all the necessary complicated switchgear Serious difficulties were soon encountered, amongst others the resonance phenomenon called the Ferranti effect At this period, when even his strongest supporters began to waver, Ferranti pushed resolutely forward, overcoming difficulty after difficulty, and undeterred by breakdowns until success crowned his efforts He frequently consulted Sir William Thomson professionally, and the latter found some of his problems of absorbing interest In particular he computed the effect produced by the rapidly alternating current in increasing the resistance of the Deptford-Trafalgar Square mains

In 1892, Ferranti resigned his post of engineer to the London Electric Supply Corporation, and devoted himself exclusively to the manufacture of electrical apparatus His works were finally established at Hollinwood, near Manchester They supply every kind of apparatus for electric lighting, and their transformers, meters, and radio apparatus are very widely used In particular Ferranti designed and installed the million volt transformer which is now in use at the National Physical Laboratory, Teddington

In 1910, Ferranti gave a remarkable presidential address to the Institution of Electrical Engineers, in which he prophesied the trend of future electrical development In the electrical age to which he looked forward all the world's drudgery would be done by automatic machines—'robots' driven electrically and controlled by human minds The enormous saving in labour and waste would be a priceless boon to humanity Assuming that everything were done as he suggested, he calculated that the average cost of an electric unit would be reduced to ⅛th of a penny He assumed that the nitrogen in the fuel would be recovered in the form of ammonium sulphate, which could be used for the intensive cultivation of home grown food Coal could be conserved, and as there would be less smoke there would be more sunshine It was a remarkable address delivered in a most pleasing and attractive way, as if it had been composed with little or no labour He told me, however, that he had spent laborious months composing it and checking the necessary calculations

Ferranti married the second daughter of Mr Francis Ince, a solicitor who gave a great impetus to the electrical industry in its early days One of Ferranti's sons, Basil, was killed in the War, after distinguishing himself as a major and gaining the military cross, another son, Vincent, is a director of Ferranti's Ferranti's home at The Hall, Baslow, Derbyshire, was fitted up with every electrical convenience, including even artificial sunshine His seaside house in Wales was also 'all electric'

He was a great motorist, and for his summer holiday he often went for a motoring tour abroad In the winter he and some of his family went to Switzerland for the winter sports On Dec 19 last he attended the meeting of the Institution of Electrical Engineers, at which Mr Haldane read a paper on a heat pump which reversed the Carnot cycle of operations Ferranti was enthusiastic over it, and reminded me that Prof Perry as well as Kelvin had advocated reversing the Carnot cycle He was just starting for his winter holiday, and was looking forward to skating and to seeing his children and grandchildren taking part in more active sports His death at Zurich on Jan 13, following an operation, came as a great shock to his many friends all over the world

Ferranti, through his father in law Mr Ince, was closely connected with Faraday House Electrical Engineering College At the old students' dinner on Oct 25, in proposing the toast of the College, he encouraged the students by reminding them of his own strenuous struggle during the days of his youth He missed in his student days, by a hairbreadth, the invention of the tungsten filament lamp and the induction motor He attributed these failures to lack of technical knowledge, and urged the students to use every endeavour to widen their knowledge One could never tell what scientific fact would give the key to an invention

Ferranti was a great inventor and engineer, one of the greatest the world has ever seen We need merely mention the mercury meter, the Ferranti alternator, the Ferranti rectifier, the Ferranti concentric cable, Ferranti switchgear, the Ferranti steam engine, the Ferranti steam valve, his system of earthing, his induction furnace, his high temperature improvements of the steam turbine, his systems of electric welding, and his high-speed spinning machinery for cotton mills There are many more Electricity supply as we know it to day was largely fashioned by him In England, in America, and practically all over the world, his name is a household word in engineering circles Yet he was a singularly modest and retiring man He never stood in the limelight or pushed himself forward for public recognition Foreigners after meeting him sometimes asked, wonderingly, "Was that the great Ferranti ?"

He was a fellow of the Royal Society, an honorary member and Faraday medallist of the Institution of Electrical Engineers, an honorary member of the American Institute of Electrical Engineers, and an honorary D Sc of the University of Manchester

A RUSSELL

PROF H L CALLENDAR, C B E, F R S

IT is with deepest regret that we record the death of Hugh Longbourne Callendar, professor of physics at the Imperial College of Science and Technology He was born in 1863, and died after a brief illness on Jan 21 last He leaves a widow and three sons

Callendar received his early education at Marlborough at a time when little encouragement was given to a brilliant scholar to take up any form of experimental science, and he passed through the school on the classical side In his first year at Trinity College, Cambridge, he received college prizes for classics and mathematics, obtained a first class in Part I of the Classical Tripos of 1884, and was bracketed sixteenth Wrangler in the Mathematical Tripos of 1885 Afterwards, however, his whole career was devoted to the experimental branches of physical science, in which he developed a degree of skill and a *flair* for accurate work that left him without a rival

Callendar's first work, on the platinum resistance thermometer, was communicated to the Royal Society in 1886, during which year he became a fellow of Trinity College, and his researches on temperature measurement were continued at the Cavendish Laboratory until 1893 After a brief interlude at the Royal Holloway College, Egham, he accepted appointment to a professorship of physics at McGill University, Montreal, remaining there for five years During this period he developed his method of continuous electrical calorimetry, the first application being the measurements by his assistant Barnes on the specific heat of water It was also at McGill that he first brought his knowledge to bear directly on the problems of engineering science, and in conjunction with Nicolson he made many valuable discoveries on the heat transmission and leakage losses from steam engine cylinders

In 1898, Callendar returned to England as Quain professor of physics at University College, London, and in 1900 he first put forward his characteristic equation for an imperfect gas which has been so useful and satisfactory in representing the properties of steam He accepted appointment as professor of physics at the Royal College of Science, now incorporated in the Imperial College of Science and Technology, in 1902, and still filled the chair at the time of his death His long occupancy of this post has been crowded with work representing not only the developments of his early researches but also brilliant and vital investigations on many new lines to which he turned his attention

Of the many services which Callendar has rendered to pure and applied science, it is difficult to say which should be placed first, but undoubtedly the most widespread utilisation of his researches lies in the applications of the platinum resistance thermometer In this instrument, Callendar not only gave to the research worker a method of the highest order of accuracy for the measurement of temperature, but also gave to the engineer and metallurgist a convenient and

practicable method of heat regulation in industrial operations To the perfection of the thermometer itself Callendar added the design of his automatic recorders and put the combination to many and varied uses His equation for an imperfect gas with his measurements of the properties of steam are similarly of universal importance It now seems so obvious that the values of the various properties of a vapour must be thermodynamically consistent with each other, yet of the many systems of steam tables in use throughout the world none possessed that vital attribute until Callendar showed the way He was spared to put the crowning touch to the edifice which he had erected, and last year saw the publication of his experimental values for steam up to and beyond the critical pressure He had long been dissatisfied with the usual presentation of conditions in the neighbourhood of the critical point, and his revelation of a differentiation in density and a latent heat beyond the temperature at which the meniscus vanishes came after a prolonged series of experiments which only he could have brought to a successful conclusion

Space does not permit of a detailed reference to Callendar's work on the gas thermometer, the radio balance, the re-determination of the specific heat of water, and the many other physical problems which he successfully attacked during his tenure in London Concurrently with these researches, he conducted a series of investigations on engineering problems connected with steam turbines and internal combustion engines, and in 1925 and 1926 he published papers on dopes and detonation, in conjunction with the staff of the Air Ministry Laboratory, which represented most valuable advances in the elucidation of that important but obscure phenomenon In all the major works which bear his name, he alone was responsible for every detail and every determination, and it may be that his most valuable contribution to science of the present day was the introduction of a new standard of accuracy for physical and engineering measurements The elimination of every possible source of error and the very highest degree of consistency alone would satisfy him

In his college lectures, Callendar was clear and concise, presenting his subject with logical sequence and perfect illustration He took few holidays, and was most happy when allowed to pursue his individual research steadily and without interruption, yet no interrupter was ever received with anything but perfect courtesy He was a good tennis player, and had won the Prince of Wales' Cup at Bisley for rifle-shooting He had been interested in motoring from its earliest days He was the inventor of a system of shorthand which is in fairly general use in some parts of the Colonies where older systems had not become firmly established prior to its advent He had no great liking for public lectures or for committee work, but accepted in his course such duties as they called He was for some years treasurer of the Physical Society of London, and was president in 1910–12 He was also president of Section A (Mathematical and Physical Science) of the British Association at the Dundee meeting in 1912 He was elected a fellow of the Royal Society in 1894, when only thirty years of age, and received the Rumford Medal in 1906 When the Physical Society of London established the Duddell Memorial Medal, to be awarded for the advancement of knowledge by the invention or design of scientific instruments, the name of the first recipient was a foregone conclusion and the medal was unanimously awarded to Callendar in 1924 He was a Hon LL D of McGill University, and at least one British university was desirous to bestow the same honour upon him, but he declined to leave his college duties during the examination period

It is pleasing to record that in the industrial world the work that Callendar did was valued, accepted, and used His steam tables were officially adopted by the turbine manufacturers of Great Britain through the British and Electrical Allied Manufacturers' Association, and used for turbine tests and contracts, and his later work on high-pressure steam was supported and financed by the manufacturers' research association He was awarded a Watt Medal by the Institution of Civil Engineers in 1898 for his work with Nicolson on the laws of condensation of steam, and received the Hawksley gold medal of the Institution of Mechanical Engineers in 1915 for his investigations into the flow of steam through nozzles and throttles, while in 1929 he was invited to deliver the Hawksley memorial lecture He was made a C B E in 1920 for his work for the Air Ministry and the Anti-Submarine Department of the Admiralty, but his most lasting memorial is the mark he has made on the science of accurate measurement H M

WE regret to announce the following deaths

Dr A J Bigney, professor of zoology in Evansville College, Indiana, and president in 1915 of the Indiana Academy of Science, on Nov 13, aged sixty five years

Prof Ralph H Curtiss, of Detroit Observatory and professor of astronomy at the University of Michigan, who was known for his work on stellar spectroscopy, on Dec 25, aged forty nine years

Dr Henry Wilson Hake, lecturer on chemistry and toxicology at Westminster Hospital Medical School, and consulting chemist, on Jan 18, aged seventy-two years

Prof F Neher, professor of organic chemistry since 1914 at Princeton University, who was known for work on the derivatives of halogenated ethers and esters, on Dec 11, aged sixty two years

Prof T Brailsford Robertson, professor of biochemistry and general physiology in the University of Adelaide since 1920 and officer in charge of investigations on the nutrition of animals for the Commonwealth Council for Scientific and Industrial Research, on Jan 25, aged forty five years

Rev F A Tondorf, director of the seismological observatory and professor of physics at Georgetown University, Washington, on Nov 29, aged fifty nine years

Sir Frank Warner, K B E, president in 1918–20 of the Textile Institute and a leading man in the silk industry of Great Britain, on Jan 23, aged sixty-seven years

News and Views

It was announced in the House of Commons on Jan 23, in reply to a question, that the Sub Committee of the Committee of Civil Research which is inquiring into the fishing industry has considered the problem of exploration for new fishing grounds, and, in view of the evidence put forward as to the need for systematic and well planned investigations, has presented an Interim Report to the Committee of Civil Research After considering this report, the Government has authorised the construction of a survey vessel at an estimated capital cost, including scientific equipment, of £80,000 The vessel is to be constructed and equipped by the Admiralty in a naval dockyard, and is to operate under the control and direction of the Hydrographer of the Navy The Government proposes to ask Parliament to provide annually a sum of £34,000 to cover running expenses in each of the five years next succeeding the completion of this vessel The Royal Research Ship *Discovery II*, a description of which was given in Nature on Nov 23, 1929, p 798, will be the pattern on which the new vessel will be constructed Specially designed for ice navigation, and with a bunker capacity sufficient to enable her to steam 7800 miles at full speed and more than 10,000 miles at economic speed, such a ship should be able to accomplish much valuable work in arctic waters *Discovery II*, however, does not carry fishing gear of commercial dimensions, such as the sister ship will presumably employ if, as the British Trawlers' Federation suggests, the survey is accompanied by practical tests on a small scale of the fishing capacity of the grounds explored

It may occasion some surprise to those not acquainted with the present fisheries' situation that a great part of the area to be surveyed lies north of the Arctic Circle The explanation of this rests upon the fact that every year the productive centre of our great sea fisheries tends to move farther north The North Sea, once the most important fishing region, has yielded pride of place to Iceland, while increasing quantities of fish are now being landed from the still more northerly waters off Greenland and Bear Island But with this movement northward the available charts and normal aids to navigation become fewer and less informative, so that our fishing pioneers labour under increasingly difficult and dangerous conditions Thus it happens that substantial expenditure in time and money is incurred even to locate grounds previously visited With capital expenditure mounting on account of the bigger ships needed, and running expenses becoming heavier due to the longer (and unproductive) journeys to and from the fishing grounds, the owners feel that they cannot undertake the desired survey work Nor is it unreasonable, as the Sub Committee of the Committee of Civil Research points out, for the industry to look to His Majesty's Government to provide, in respect of the new fishing grounds, the same type of information as was formerly supplied in regard to the nearer fishing grounds

The expedition of the British Museum to British Honduras to excavate Maya antiquities left England on Jan 23 Owing to the inability of Capt T A Joyce to accompany the expedition this season, it is under the command of Capt E L Gruning He is accompanied by Mr Robert Ashton and Mr E H Nelson The expedition will again start from Punta Gorda, after a short stay at Belize, proceeding up the Mojo River to Pusilhá by canoe and motor tractor Investigations will be resumed at the point at which they came to an end in 1929 Of the six large monoliths discovered last year, two remain to be deciphered and brought back Further excavations will be made in the cave discovered last year It will be remembered that the deposits in this cave, which yielded such a large store of remarkable pottery fragments, suggested that it had been used as a domestic rubbish shute by the inhabitants of a village site above In addition to carrying further the work begun last season, Capt Gruning proposes to examine a large number of ruins on the other bank of the river—an investigation which the topographical conditions suggest should provide much interesting material bearing upon cultural sequences and development in the area as a whole

It is announced that the material obtained by the British Honduras expedition in 1929 will shortly be on exhibition in the British Museum Of this material a considerable proportion consisted of literally thousands of fragments of pottery which have been laboriously sorted, classified, and pieced together in the months which have elapsed since the members of the expedition returned to England The results will well repay close study The quality of the pottery is for the most part remarkable in the fineness both of its texture and finish, while the painted ornament, some of it unique in design, is beautiful in colour and style The reconstruction of so many complete pieces from such a mass of heterogeneous sherds is a remarkable testimony to the skill and patience of the museum staff The variety of style in form and decoration, which will be apparent when the material is seen as a whole, will serve to emphasise its importance as a clue to cultural development and in itself point to the need of a complete investigation of the site Unfortunately, the British Museum itself has no funds for continuing the investigation on this or other sites in British Honduras In previous years the expedition has been financed by donations, £200 a year having been contributed from a fund given to the Museum by Mr John A Roebling, an American benefactor A similar amount has also been contributed by the Colony of British Honduras In appealing for further contributions, the Director of the Museum points out that this is an opportunity for investigating a hitherto unknown culture within the British Empire and that it gives British archæologists a security of tenure not obtainable in the excavation of prehistoric sites in the Old World

The International Union for Pure and Applied Chemistry has now been reconstituted and brings in the German chemical societies under mutually acceptable conditions Before this could be accomplished it was necessary for three of the leading German chemical societies to form a joint committee for international occasions This Verband Deutscher Chemischer Vereine has been able to negotiate with the Union Internationale de la Chemie Pure et Appliquée The new constitution and statutes are given in an article by Prof Haber, president of the Verband D C V in the *Zeitschrift für Angewandte Chemie* of Dec 7 The new title is to be Union Internationale de Chimie, omitting the words pure and applied The new statutes were agreed upon at Scheveningen in June 1929 If there are minor ambiguities in the German translation the French text is to be taken as official German adhesion to the reconstituted Union is subject to the understanding that in its new constitution the International Research Council will not hinder the autonomy and free development of the Union For German international chemical interests, communications may now be addressed to the secretary of the Verband D C V, Herrn Geheimrat Prof Dr Marckwald, Berlin, W 10, Sigismundstr 4

At the general assembly of the International Research Council which was held at Brussels in July 1928, the executive committee of the Council was authorised to approve any modifications which the Unions might desire to make in their statutes so long as these did not conflict with the statutes of the Council At the same meeting a committee was appointed to consider what modifications should be made in the statutes of the Council at the end of the present convention, which is in force up to Dec 31, 1931 This committee met in Paris in September last, and its recommendations are now before the executive committee of the Research Council on which all the Unions are represented The present general secretary of the International Research Council is Sir Henry Lyons, c/o The Royal Society, Burlington House, London, W

To everyone interested in research the report for last year of the British Electrical and Allied Industries Research Association will be very encouraging Not only has substantial progress been made in scientific researches on various important branches of the industry but also the finances of the Association are in a very satisfactory state This was due to the prompt response made by electricity supply undertakings to an appeal for assistance, the automatic reduction of the Government grant being more than compensated by the new subscriptions Valuable researches are being carried on for the Electricity Commission and for the Central Electricity Board Special mention is made of the work done in elaborating methods for measuring the losses which occur in dielectrics when subjected to great electric stresses Methods have been devised for the accurate measurement of the heat transferred from electric cables to the ducts containing them and to the heating of deeply buried cables Researches on the losses in dielectrics at radio frequency are being carried out at the City and Guilds College and at the East London College A very complete résumé of all the available information on the interference of power lines with telegraph, telephone, and radio circuits has been compiled Experiments to clear up difficulties in the practical theory of 'interference' have also been made Researches on the effect of earth returns under all conditions of working have received special attention as they have a very practical bearing on the working of the 'grid' system in Great Britain

In his Friday evening discourse on Jan 24 at the Royal Institution on "Cellulose in the Light of the X Rays", Sir William Bragg stated that when a fine pencil of X rays traverses a fibre of any kind, cotton, hemp, ramie, jute, or such like, the mode of scattering indicates that cellulose is composed, in large part at least, of a mass of small crystals That the same X ray diagram is obtained from all fibres, even from animal cellulose, shows that we are dealing always with one and the same substance It can further be deduced that there is in each crystal a periodicity parallel to the direction of the fibre, and this quantity can be determined exactly The essential feature of the construction for cellulose suggested by both X-ray and by chemical evidence is the long chain of many links The bonds that tie the links together are far stronger than those that tie the chain together, those that keep each of the cellulose chains together are as strong as the bonds in the diamond Indeed, how could a thread carry a suspended weight unless there were great forces in play? But the side to side forces are far from being so strong There seems ground to suppose that bundles of these long chains form 'crystallites', small crystalline masses of which the cellulose is largely composed When the thread is stretched the X rays show that these bundles go more and more into line When the stress is too great the bundles begin to slide past one another, and if the force is too great, they let go and the thread breaks

The Council of the Institution of Electrical Engineers has made the ninth award of the Faraday Medal to Sir Ernest Rutherford The Faraday Medal is awarded by the Council of the Institution not more frequently than once a year either for notable scientific or industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science without restriction as regards nationality, country of residence, or membership of the Institution

Dr Louis A Bauer, Director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington since the establishment of the Department on April 1, 1904, retired from this position on Jan 1, last, with the title of director emeritus Provision is being made whereby if his health permit he may carry on studies during the coming year as a research associate of the Institution Mr John A Fleming, associated with Dr Bauer as chief assistant in the Department of Terrestrial Magnetism since 1904, as assistant director for observational and administrative work during 1922 and 1923, and as assistant director in charge of operations since 1924,

continues in charge of the work of the Department with the title of acting director

Dr Friedrich Küstner, director emeritus of the Bonn Observatory, has been made an honorary member of the American Astronomical Society, according to the provision that permits the election of one such member each year Seven other living astronomers have been thus honoured Dyson, Charlier, Turner, Baillaud, Eddington Wolf, and Deslandres Kustner is best known for his detection, in 1888, of the variation of latitude, from observations made with a zenith telescope at Berlin His two fundamental star catalogues, carried out with the meridian circle at Bonn, are unexcelled in accuracy and thoroughness, and are universally regarded as models for this class of work With the comparatively modest equipment of the Bonn Observatory he has carried out a long series of determinations of radial velocities, and has shown that large telescopes are not necessary to secure results of a high order of accuracy As a by product of this work he was the first to determine the parallax of the sun by observing radial velocities of stars

The Rivers Memorial Medal for 1929 has been awarded by the council of the Royal Anthropological Institute to Mr J H Hutton of the Indian Civil Service for his services to anthropology in the field in Assam Mr Hutton is the author of a monograph on "The Angami Nagas", published for the Assam Government, and a frequent contributor to scientific periodicals of notes on the ethnography of the Naga hill tribes He has written the introductions to several of the monographs on the ethnography of the Nagas, published for the Government and written by members of the Civil Service and others, and it is largely owing to his energy and keen interest as director of ethnographical work, in which he has received the full support of the Government authorities, that a large amount of valuable information relating to the Naga tribes has been collected by himself and his subordinates in the course of their official duties

The Frazer Lecture, which was founded as a tribute to the work of Sir James Frazer, and is delivered biennally in turn in the universities with which he has been intimately connected —Oxford, Cambridge, Glasgow, and Liverpool—will be delivered this year at Oxford on Feb 22 The lecturer is Dr P Rivet of Paris, the distinguished authority on the primitive cultures of America The subject of the lecture will be "Civilisation américaine et océanienne" Dr Rivet proposes to be in England for some days, and during his stay will deliver several lectures On Feb 20 he will lecture at the University of Bristol on "Les Grandes Civilisations Andéennes de la République de l'Equateur" On Feb 25 he will be entertained at Cambridge and will deliver a lecture on "Les Races océaniennes en Amérique" On Feb 27 he will be entertained at lunch in London by the Anglo-French Institute on behalf of Sir James and Lady Frazer, and in the evening of the same day will address the Institut Français, when his subject will be "Voyage au Mexique" The following week he will be at Manchester on Mar 5, when he will again give an account of his travels in Mexico, and on Mar 6 will read a paper before a joint meeting of the Anthropological Society of the University of London and the Royal Anthropological Institute at the London School of Economics at 8 P M, his subject being "La Méthode historique et la Méthode évolutioniste en Ethnologie"

On April 5-9, the American Society of Mechanical Engineers will celebrate its fiftieth anniversary, and Mr W H Patchell and Mr L St L Pendred have been appointed to represent the Institution of Mechanical Engineers during the celebrations It was on Feb 16, 1880, in the office of the *American Machinist*, that the preliminary meeting of the Society was held, while the inaugural meeting took place on April 9, 1880, in the auditorium of the Stevens Institute of Technology at Hoboken Prof R H Thurston, as well known for his work for engineering education as for his researches and writings, was the first president, while his immediate successors included such as Leavitt, Sweet, Sellers, Babcock, and Towne, all pioneers in their respective spheres The Stevens Institute is preparing an elaborate pageant depicting the early activities of the Society, a memorial service will be held at the Cathedral of St John the Divine New York, and the subsequent proceedings will be held in Washington and will include a reception at White House It is scarcely necessary to remind our readers that Mr Hoover, the president of the United States, is himself an eminent mining engineer A special feature of the proceedings will be the reading of sixteen papers bearing upon the influence of engineering upon civilisation, each of the papers summarising and evaluating the contributions of engineering to the cultural, social, economic and political life in one of the sixteen selected geographical divisions of the world

Two publications relating to the conference of Empire Meteorologists, held in London in August last, have been received They refer to the agricultural section of the conference, which was arranged at the suggestion of the Empire Marketing Board, and was held under the chairmanship of Sir Napier Shaw The first is simply a general report, running to sixteen pages, which gives details of the organisation of the section and of the resolutions arrived at in regard to future research in agricultural meteorology It also contains various definitions that indicate which, in the opinion of the Conference, are the branches of agriculture particularly affected by weather or climate, and which are the subjects in the domains of the meteorologist and the agricultural research worker respectively Among the resolutions may be noted one which was arrived at by a special committee, namely, that the month is too long a period for summarising, for publication, statistics of agricultural meteorology, and that the week should be used in preference

The second publication is a comparatively bulky volume running to more than three hundred pages, entitled "Papers and Discussions", giving the full substance of all the papers read at the Conference,

and of the discussions that followed them. Since each is followed in addition by a considerable bibliography of recent papers on that particular subject, it will be understood that this volume will prove very valuable to research workers throughout the Empire. The papers cover a wide field, which includes the influence of weather on crops, insect pests, the growth and fruiting of various fruit trees, etc., and the relationship between individual meteorological factors and the physiological processes of plant growth. There is a subject index that facilitates the extraction of particular items of information—a point of some importance to those practical farmers who may be sufficiently up to date in their methods to make use of information of this kind, but have little time for study.

The ninth Annual Report of the Animal Breeding Research Department of the University of Edinburgh, by Prof. F. A. E. Crew, the director, indicates in small compass the great variety of investigations being undertaken by that institution. Apart from many researches in the physiology of sex and reproduction in birds and mammals, studies in subjects bearing more or less directly upon the problems of the farmer and breeder have touched upon all the common domestic animals of Great Britain. The new building which has been designed for the work of the Department is likely to be in full occupation early this year, and this should add greatly to the facilities of the many research workers who make use of the institution. Much has been gained by the attachment of the Imperial Bureau of Animal Genetics, and already the production is forecast of a quarterly bulletin on the breeding of domestic animals, especially of those within the Empire. Through the generosity of Mr. T. B. Macaulay, a new lectureship, with assistantships and maintenance, has been endowed, and a sum of £5000 has been offered for the purchase of a farm, designed to be equipped, stocked, and run as a fully functioning experimental station.

The Report of the British Photographic Research Association for the year 1928–29 has recently been issued. It shows a continued and satisfactory progress, with a few changes in the personnel, as of course is to be expected. In the endeavour to estimate the value of investigational work, there is nothing more deceptive as a guide than the number of communications published, but we cannot help noticing that while three papers have been published, eleven "Private and Confidential Reports" have been circulated to members. We hope that the private and confidential section of the work will tend to diminish by the transfer of what might perhaps belong to it from some points of view, to the published section. Judging merely from some of the titles, it appears that this might well have been done during the past year.

A wireless station for meteorological purposes has been erected in Franz Josef Land by the Soviet Government. A report of the expedition that was charged with the task is contained in a recent issue of the *Weekly News Bulletin* (No. 44) of the Soviet Society for Cultural Relations with Foreign Countries. The icebreaker *Sedov* left Archangel in July 1929. After some difficulty with pack ice, Hooker Island was reached and a landing made. Newton Island and Cape Flora were then visited; eventually Scott Keltie Island to the north of Hooker Island was chosen for the station which was erected during August and put in charge of Prof. O. Schmidt. The *Sedov* pushed north along British Channel and visited Rudolf and Nansen Islands before returning to Europe. Geological and oceanographical results are promised.

Owing to unusual ice conditions in the Ross Sea, Admiral Byrd's American Antarctic expedition is in some danger of being held in the south for another winter. The *Times* reports that Admiral Byrd from his station near the Bay of Whales on the Ross Barrier has sent a wireless message asking for help. His ship, *City of New York*, is unable to force its way south through the pack ice in order to pick up the expedition, and the assistance of Norwegian and British whalers, of which there are several in the Ross Sea, has been asked for. There seems to be about seventy five miles of pack ice lying some two hundred miles north of Admiral Byrd's camp, and offering an obstacle to his ship. Even if the expedition is unable to escape, there should be no danger of starvation, since abundant stores were landed last year and seals are numerous.

Enderby Land in the Antarctic, lying on the Antarctic Circle in about long. 50° E., was discovered by Biscoe in 1831 and was not sighted again until December 1929. To the east of it in about the same latitude, in long. 60° E., Kemp Land, reported in 1833 by a sealer of that name, appears on the maps. Despatches to the *Times* show that the *Discovery* expedition of Sir Douglas Mawson and the *Norvegia* expedition of Capt. Riiser Larsen have both made considerable discoveries by sea and air and have met in the neighbourhood of Enderby Land. Sir Douglas Mawson has rediscovered Kemp Land and charted a new stretch of coast line to the east, which he has named MacRobertson Land. This evidently continues in the direction of Wilhelm Land and marks the continuity of land south of the Indian Ocean. The *Norvegia* on Dec. 22 found land between Kemp and Enderby Lands and charted the coast from long. 55° E. past Biscoe's Cape Ann to long. 43° E. Two weeks later Sir Douglas Mawson's expedition landed on a rocky coast in Enderby Land in lat. 66° 30′ S., long. 53° 30′ E., and found it to be built of ancient crystalline rocks, which proves the continuance of the Antarctic plateau into that area. Several lofty ice free peaks were noted to the south-south west. Many penguins and other sea birds were nesting along the coastal rocks. The frequency of huge tabular icebergs in the vicinity indicates the existence of tongues of the ice sheet not far off and probably to the east.

Among the recent acquisitions of the British Museum (Natural History) are the following. Prof. A. C. Seward, of Cambridge, has presented to the Department of Entomology a large collection of insect galls and gall makers from various localities in Great Britain. The plants upon which the galls were found

belong to some 28 genera and many of the specimens date back nearly to 1860 A correlation of these early records with present day knowledge should therefore render it possible to form some idea of the way in which many species of gall makers have extended their range The recent Oxford University Expedition to British Guiana, for the purpose of studying life in the upper levels of a tropical forest, has handed over some 10,000 insects of various orders as part of the proceeds of its work This collection derives special interest from having been made almost entirely in primitive jungle, as distinct from second growth forest, and from the fact that it includes many specimens obtained in trees at heights of 60 100 feet The value that the common pheasant may sometimes possess from an agricultural point of view is illustrated by a series of 243 larvæ, or grubs, of the St Mark's fly (*Bibio marci* Linn) found in the crop of a hen pheasant, and presented by Mr Mark Crapp, of Liskeard The larvæ of the various species of *Bibio*, of which a number occur in Great Britain, live in colonies in the soil and do a certain amount of damage to the roots of grasses and other plants As a further result of a collecting trip to South Africa last year, the mineral collection has received this month seven lots of material from South Africa The collection of diatoms in the Department of Botany of the British Museum is both in historical value and in size the most important in existence It has recently been enhanced by the bequest of about 12,500 slides which formed the collection of the late Wynne E Baxter This contains nearly 5000 slides from the famous collection of Frederick Kitton and a separate type collection arranged according to Van Heurck's treatise on the Diatomaceæ which was translated by Baxter in 1896

SIR ALFRED YARROW has been elected an honorary member of the Institution of Civil Engineers

IT is announced in the *Times* that the residuary estate of the late Mr George de Arroyave Lopes, which is to go to the Zoological Society of London to form a De Arroyave Fund, will amount to more than £70,000 The Fund is to be applied for the upkeep and improvement of the Zoological Gardens and for the objects of the Society, the only conditions being that the Society hang the portrait of the testator's mother in its board room and maintain the family grave of Mr de Lopes and his own grave

THE Botanical Museum of the University of Zurich has voted the sum of 4000 Swiss francs, distributed over three years, towards a hydrobiological investigation of high Alpine Swiss lakes Candidates for grants should apply to the president of the Commission, Prof Dr Hans Schinz, Biberlinstrasse 15, Zurich 7, from whom the detailed programme of work may be obtained Those of foreign nationality must have spent at least one year at a Swiss university in order to be eligible

THE first photograph of the skull of *Sinanthropus* or Peking man recently discovered in China was exhibited by Prof Elliot Smith at the meeting of the Royal Anthropological Institute on Jan 21 Prof Elliot Smith gave a brief demonstration of the photograph, pointing out the distinctive features to which attention has already been directed in the preliminary accounts of the skull which have appeared in our columns (Dec 28, 1929, p 973) and in the daily Press

A JOINT meeting of the Royal Aeronautical Society and the Royal Meteorological Society will be held on Friday, Mar 14, at 6 30 P M, at which a lecture will be delivered by Dr Fridtjof Nansen on "The Aims and Objects of the Aeroarctic" The meeting will be held in the Lecture Hall of the Institution of Electrical Engineers, Savoy Place, when Lord Thomson, Secretary of State for Air, will take the chair After the lecture a dinner in honour of Prof Nansen will be held at the Savoy Hotel

AT the anniversary meeting of the Royal Anthropological Institute held on Jan 28, the following officers and new members of council were elected for the year 1930–31 —*President* Prof J L Myres, *Hon Secretary* Mr E N Fallaize, *Hon Treasurer* Mr G D Hornblower, *Hon Editor* Mr H J Braunholtz, *New Members of Council* Miss G Caton Thompson, Prof W Le Gros Clark, Dr E E Evans Pritchard, Mr C F Hawkes, Mr T A Joyce, Mr A Keiller, Lord Raglan, and Miss M Tildesley

WE have received No 9 of the present series of the *Recueil des Travaux Chimiques des Pays Bas*, published in August last, which is a complimentary number dedicated to Prof A F Holleman on his seventieth birthday, The volume contains short papers by chemists of many countries and covering a wide range of subjects Some of these give useful summaries of researches carried out by the authors over a series of years

THE Ministry of Health has issued a memorandum (Memo 122 C/T) on the costs at residential institutions for the treatment of tuberculosis The table has been compiled on the same lines as in former years, and the information given should be of assistance to authorities in enabling them to check their expenditure and to take such steps as may be necessary to secure efficient and economical administration of their institutions

WE have received *Technical Paper* No 1 on Water Pollution Research, Department of Scientific and Industrial Research (London H M Stationery Office, 6*d* net), which deals with water softening, the base exchange or zeolite process, and gives a summary of existing knowledge on this subject The report has been prepared by Dr A R Martin under the direction of Prof G T Morgan, in the Department's Chemical Research Laboratory at Toddington

THE semi official Institute of Physical and Chemical Research of Tokyo has published a *Guide* which states that the object of the Institute is to assist industrial development by investigations in pure science It occupies a site of nearly 40,000 square metres in Tokyo and has a capital of £570,000 derived largely from official sources Its expenditure for the year ending Mar 31, 1929, was £67,000, including an annual subsidy of £25,000 from Government Its

staff consists of 256 directly engaged in investigations and about three hundred assistants, some of whom are engaged in experimental work in factories

THE effects of the presence and absence of ultra-violet radiation have been the subject of experiment in the Aquarium of the New York Zoological Society The tests were mostly carried out upon fishes The detailed results are to be embodied in technical publications, but the Annual Report of the Director of the Aquarium states that the benefit of such irradiations under proper control, and the deleterious effect of their absence, were satisfactorily demonstrated They include effects on health, fecundity, and growth of fishes and turtles of various species, as well as various minor effects upon representatives of other groups.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A headmaster of the Euclid Street Secondary School (Co educational), Swindon—The Secretary to the Education Committee, 22 Regent Circus, Swindon (Feb 8) A mathematics master and a chemistry master at the Acton Junior Technical School—J E. Smart, Municipal Offices, Acton, W 3 (Feb 8) A chief assistant under the Scottish Society for Research in Plant-Breeding, for research into virus disease of potatoes—The Secretary, Scottish Society for Research in Plant Breeding, 3 George IV Bridge, Edinburgh (Feb 15) An oil seeds specialist in the Madras Agricultural Department—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S W 1 (Feb 22) A senior and a junior geologist and a junior mineralogist in the department of the Geological Survey of Southern Rhodesia—The Secretary, Office of the High Commissioner for Southern Rhodesia, Crown House, Aldwych, W C 2 (Mar 31) A junior assistant under the Directorate of Ballistics Research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S E 18 A temporary science mistress at the Borough Polytechnic Institute—The Principal, Borough Polytechnic Institute, Borough Road, S E A Secretary of Clifton College — The Secretary, Clifton College, Bristol

Our Astronomical Column.

Astro-Photography of the Future —The French journal, *L'Illustration* for Dec 21 contains an article by Dr G W Ritchey, late of the Yerkes and Mount Wilson Observatories, entitled, " De Nouveaux Firmaments Dévoilés par l'Astrophotographie " The article is enriched by some admirable large scale reproductions of Dr Ritchey's beautiful photographs of nebulæ taken with the 60 inch reflector of Mount Wilson Observatory, and is itself mainly a descriptive and speculative commentary on those photographs Those who attended Dr Ritchey's lectures in London a few years ago will remember with pleasure the numerous excellent lantern slides with which they were illustrated In the course of some reflections on the future possibilities of astro photography, Dr Ritchey remarks that, in spite of many examples of the achievement of the seemingly impossible, if to day an experienced astronomer should venture to affirm that in a dozen years our knowledge of the universe would be enormously increased by the employment of photographic telescopes a hundred times more powerful than our present ones, he would be considered a heretic Nevertheless, adds Dr Ritchey, this is a possibility capable of immediate realisation The super telescopes which he foreshadows will give us large scale photographs of thousands of spiral nebulæ in each stage of their development, with details of structure more delicate than those visible in existing photographs of the Andromeda nebula By their comparison and classification there will gradually but surely become unveiled the story of the evolution of these immense stellar systems of space

Washington Naval Observatory —The Report of this observatory for 1929 has just come to hand The eclipse expedition to Iloilo, Philippines, "was favoured with almost perfect weather conditions" Eighty photographs were taken, in addition to sketches and motion pictures taken from aeroplanes Appreciation is expressed for the help given by Prof W A Cogshall, of Indiana University, who joined the expedition

The American Ephemeris, like the British Nautical Almanac, is introducing several changes in 1931 The mean equinox of the beginning of the year is used for the longitude and rectangular co ordinates of the sun In the prediction of eclipses the sun's longitude from Newcomb's tables is increased by 1 5", and in the prediction of eclipses and occultations the moon's longitude is increased by 7" A new zodiacal catalogue is in progress of formation which will contain all stars down to magnitude 7 0 that are liable to occultation The 26 inch equatorial was used for observations of occultations of double stars and of the satellites of the planets, theoretical researches have also been made on the satellites of Mars and Saturn

An interesting graph is given of sunspot activity since 1923, when the minimum occurred, the increase in activity in 1925 was very rapid, the highest maximum occurred before the middle of 1926, a second, but lower, maximum occurred just two years later There is a decided depression between the two maxima, the curve resembles that of two sunspot cycles earlier

Preparations are being made for observing Eros at its coming near approach, and many observations have been made of the stars selected as comparison stars

Radial Motions of the O-type Stars —Prof C D Perrine discusses the radial motions of these stars in *Astr Nach*, 5672 After *correcting* for solar motion, he finds that the stars without emission lines show a decided positive velocity, while those with emission lines show negative velocity The proper motions do not give any support to the view that the difference is in the space velocities of the stars, and he concludes that it arises from internal motions of expansion and contraction He reached a similar conclusion concerning the planetary nebulæ in *Astr Nach*, 5670 He further suggests that the variable radial velocity which has been found in some of these stars, and ascribed to orbital motion, may be due to alternate expansion and contraction This is held by many to be the explanation of the shift of spectral lines in the Cepheid variables Prof Perrine also suggests that the planetary nebulæ and the *O* and the *B* type stars form a progressive series of objects This, however, does not seem to harmonise with his conclusion that all the planetary nebulæ are the relics of former novæ

Research Items

New Light on Drake's Voyage.—Two documents discovered by Miss E. G. R. Taylor in the British Museum throw much light on the plans of Drake's voyage of 1577. One of these documents, reproduced in part with an article in the *Geographical Journal* for January, is a draft plan for the voyage. Unfortunately, the document is mutilated, but careful examination reveals that the ships were to go and return by Magellan's Straits, that unknown shores not in the possession of any Christian prince were to be visited, and that the voyage was to be extended to 30°. Miss Taylor believes that the coast to be examined was not that of western America, which was already in Spanish possession between 40° S. and 35° N., but that of Terra Australis as shown on the Ortelius map of 1570. This coast ran north-west from the Strait of Magellan across the Pacific to the Moluccas. The second document is John Winter's report made on his return to England after losing touch with Drake in the South Seas. Winter's report shows that the westerly winds of the South Pacific made a westerly course impossible for him and no doubt encouraged Drake to turn north to harry the Spaniards and accept the alternative plan of seeking for the Strait of Anian. On his failure to find this strait in lat. 48° N., he turned to his original destination of the Moluccas.

Birds of the *Adventure* and *Beagle*.—When H.M.S. *Adventure* and *Beagle* were sent on a survey to the Strait of Magellan in 1826, the officers were instructed to collect rare, new, or interesting objects of natural history. Capt. King faithfully carried out the order, sending a first collection of 78 specimens of birds from Rio de Janeiro in 1827, and bringing with him on his return in 1830 a further collection, the numbers of which are unknown. These collections contained many new species of birds, and in view of the doubt which has existed as to the final resting-place of the type specimens, Surgeon Rear-Admiral J. H. Stenhouse has given short descriptions of the twenty-one specimens now in the Royal Scottish Museum in Edinburgh (*Scot. Nat.*, p. 181, 1929). Seven appear to be types or co-types of species described as new, but of these three have since been recognised as synonymous.

American Chipmunks.—The "North American Fauna" series of the Biological Survey of the U.S. Department of Agriculture continues its useful course with a revision of the chipmunks. Some impression of the amount of concentrated observation in present-day systematics may be gained from the fact that Arthur H. Howell, in writing this monograph, had at his disposal 1349 specimens of one genus with one species and 13,205 of another with 16 species. The result has been an increase in the number of geographical races recognised. Where *Tamias*, last revised in 1886, had two races, there are now five in a compact species, and where *Eutamias*, revised by Allen in 1890, had 23 forms, 60 have now been recognised. Something of the effect of diverse environmental conditions is suggested by the compactness of the eastern genus, and the extraordinary breaking up of the western genus into a multitude of forms. Interesting accounts are given of burrowing and nesting, food storing and hibernation, breeding and feeding habits, and the descriptions of the various races are marked by a careful discrimination between summer and winter pelages. The chipmunks, particularly the western forms of the mountains and wildernesses, are of little economic significance, but they are familiar to most Americans, since they approach townships and cities with much more freedom than the native squirrel of Great Britain.

Crabs from Panama.—Mr. Lee Boone, member of the research staff of the Tropical Research Station of the New York Zoological Society, describes several very rare crabs in his paper "A Collection of Brachyuran Crustacea from the Bay of Panama and the Fresh Waters of the Canal Zone" (*Bulletin of the American Museum of Natural History*, Vol. 58, Art. 11, New York, 1929). The crabs were collected by Dr. Willard G. Van Name and his party, during a trip to the Isthmus of Panama and Pearl Islands in the spring of 1926, several hundreds being obtained, all of great interest. Among other rarities were two specimens of *Pitho quinquedentata*, one a female which is the first seen, as hitherto only two males were known, and a very fine example of the 'periscope-eyed' crab, *Euphylax dovii*, one of the Portunidæ. New records were obtained of the large fresh-water crab *Pseudothelphusa richmondi* showing an extended southern range. In this species the young, as in other Potamonidæ, are like the parent at birth, omitting all larval stages. In the present case the abbreviated life-history is probably correlated with the fact that in the dry season there is frequently no water in the stream beds in which the crab makes its home. The paper is illustrated by good photographs.

Studies on *Pectinatella*.—C. M. Brooks (*Proc. Acad. Nat. Sci. Philadelphia*, vol. 81, 1929) records observations on *Pectinatella magnifica*, the largest of the colonial fresh-water Polyzoa, the colonial mass of which sometimes exceeds two feet in diameter. This large gelatinous mass is hollow in the centre and there live flatworms, protozoa, snails, and crustacea; the flatworms are especially numerous and their eggs also are almost always to be found. The young flatworms appear about the time the statoblasts of *Pectinatella* break open and they devour the polypides in large numbers. The formation of statoblasts in *Pectinatella* begins in early autumn and continues until stopped by cold weather. The statoblasts are the chief means of distributing the species. When they first appear they are covered with a layer of jelly which prevents them clinging to the parent colony and they are readily dislodged and swept away by currents in the water, the zone of air-filled cells keeping the statoblast afloat. The covering of jelly soon decays and the hooks then exposed attach the statoblast to floating debris or to other objects. The statoblast develops steadily from the time it is fully formed until the polypide is produced, but the rate of development depends largely on the temperature. The author adds details of the anatomy of the polypide and states that scattered through the mass of food in the stomach are large nuclei, vacuolated and in degeneration, of cells which have migrated from the wall of the stomach possibly to aid in digestion.

Errors in Precise Levelling.—Apart from movements of the earth's crust, considerable errors in precise levelling may occur in several ways. Movements of the peg or bench mark during the night or between successive seasons is a source that cannot always be obviated. The small but appreciable error due to the use of wooden staves is to be prevented in the survey of India in future by the use of invar staves. Irregular refraction may be serious on a long continuous gradient. Lastly, the crossing of wide unbridged rivers involves a great loss of accuracy. In *Professional Papers*, No. 22, Survey of India,

Capt G Bomford discusses the errors connected with the last three sources Recommendations are made for levelling across unbridged rivers in the primary net Micrometer eyepieces should be used Crossings should be made at a number of sites covering some miles of the banks Sites below river junctions should be avoided Directions are given for the use of sites in the middle of the river when the width renders this necessary The paper discusses many points of great importance

Properties of β-Particles —Collisions between β particles and electrons or atomic nuclei are less easy to study than those of α particles, but two recent investigations indicate that the correct laws of interaction have yet to be derived theoretically One paper on this subject appears in a recent issue of the *Annalen der Physik* (No 7), by O Klemperer, and deals with the scattering of electrons with energies equivalent to 9 kilovolts and 18 kilovolts respectively These were drawn from a hot filament, and examined by a Geiger electrical counter after passage through thin films of celluloid, beryllium, or aluminium, their angular distribution could not be reconciled with any of the usual laws which were tried The other paper on the same subject is by E J Williams and F R Terroux, in the January issue of the *Proceedings of the Royal Society*, and is concerned with the tracks of rather faster β particles in a Wilson cloud chamber The results show that the classical theory gives only the order of magnitude both of the primary ionisation produced and of the frequency of production of branched tracks, the observed values being appreciably greater than the classical values, and following moreover a different law of variation with the velocity of the particle The deflection of the β particles in branch collisions does correspond, however, approximately to the momentum of the branch, contrary to the results found by Prof C T R Wilson for slower rays

Radioactive Constants —The question of the invariability of the decay constants of radioactive elements has been discussed by Mme P Curie in two papers in the September number of the *Journal de Physique* In the first of these, commenting on a previous paper by L Bogojavlensky (see NATURE, June 8, 1929, p 872), she points out that very stringent precautions must be observed before the existence of any change in a constant with position on the earth's surface can be regarded as established In the second, she describes briefly a number of experiments which have been made by her, or under her direction, in attempts to influence the normal course of radioactive disintegration These have been made upon radium, radon, and polonium, by exposure to various types of radiation, and although some of the observations have still to be accounted for in detail, Mme Curie believes that in no case do the results obtained furnish any certain evidence of departure from the generally accepted laws

Electrons and Protons —A theory of positive electricity has been put forward by Dr P A M Dirac in the January number of the *Proceedings of the Royal Society* The relativity quantum theory of an electron leads to a wave equation which possesses solutions corresponding to negative energies—the energy of the electron of ordinary experiment being reckoned as positive—and although there are serious difficulties encountered in any immediate attempt to associate these negative states with protons, the existence of positive electricity can be predicted by a fairly direct line of argument Since the stable states of an electron are those of lowest energy, all the electrons would tend to fall into the negative energy states—with emission of radiation—were it not for the Pauli exclusion principle, which prevents more than one electron from going to any one state If, however, it is assumed that "there are so many electrons in the world that all the states of negative energy are occupied except perhaps a few ", it may be supposed that the infinite number of electrons present in any volume will remain undetectable if uniformly distributed, and only the few 'holes', or missing states of negative energy will be amenable to observation The step is then made of regarding these 'holes' as '*things of positive energy*' which are identified with the protons A difficulty now arises in ordinary electromagnetic theory which apparently has to cope with the presence of negative electricity of infinite density, this is met by supposing that for ordinary purposes volume charges must be measured by departures from a 'normal state of electrification', which is "the one where every electronic state of negative energy and none of positive energy is occupied" The problem of the large mass of the proton, as compared with that of the electron, is not discussed in detail, but a possible line of attack is indicated Dr Dirac has included the minimum of mathematical analysis in this paper, which can be followed in all essential points by anyone acquainted with the principles of the quantum theory

Relation between Specific Heat and Temperature —The *Atti della Pontificia Accademia delle Scienze* (*Nuovi Lincei*) for 1929 contains a communication by A Denizot on a relation existing between specific heat and temperature This author has previously directed attention to the formula, $c = a \log T$, according to which the specific heat is proportional to the logarithm of the absolute temperature This expression is purely empirical and holds only for solid elements. If the values of a are plotted as ordinates against the atomic numbers N as abscissæ, a curve is obtained which is probably continuous under certain conditions and extends at one end to sodium (N 11) and lithium (N 3), and at the other to bismuth (N 83) There is, however, a gap left by the rare earth elements (N 56 72), and the values for boron, potassium, and nickel do not fall on the curve Although no theoretical foundation exists for the curve, yet the marked agreement shown between the calculated and observed values of the specific heats for most of the elements seems to justify its use for calculating the specific heats of the rare earth elements, zirconium, etc, and also the atomic weights of the recently discovered elements, masurium, florentium, and rhenium

Gibbs's Absorption Equation —The December number of the *Journal of the American Chemical Society* contains a paper by McBain and Du Bois in which experiments on absorption in a liquid gas interface, supplementing those already noticed in NATURE (120, p 819, 1927) are described The results, it is claimed, support the conclusion arrived at in the earlier experiments that the surface of an ordinary solution is a unimolecular surface layer of orientated molecules which serve as points of support for the growth of chains of orientated molecules relatively far into the solution, such chains being evanescent, constantly breaking up as a result of thermal vibrations and constantly being replaced The absorbed amount can be several times that which is compatible with the well known equation of Gibbs When a bubble passes through a solution of a simple substance, it can carry with it from two to eight times as much solute as is predicted by that equation, and from two to four times that which can be accommodated in a monomolecular film of closely packed, vertically orientated molecules It is suggested that the use of Gibbs's equation to calculate absorption is artificial.

Insects Infesting Stored Cacao [1]

THE Empire Marketing Board, in establishing a Committee on Infestation of Stored Products, has recognised the importance of dealing with the losses, occasioned both in transit and storage, by insect and other damage to a wide range of foodstuffs By means of a series of grants made to the Imperial College of Science, the Board has enabled that institution to establish at Slough a special laboratory for stored products research At present, attention is being mainly concentrated on the insect problems affecting cacao and dried fruits, and on fungus damage to cacao and copra This work is under the general direction of Prof J W Munro, and, as experience and facilities increase, it will doubtlessly embrace the study of other stored products in addition to those mentioned

A report on insect infestation conditions prevailing in cacao stores in certain of the London docks and wharves, has been prepared for the Marketing Board's Committee on Stored Products by Messrs J W Munro and W S Thompson This shows that the prevention and control of the losses at present occasioned by cacao insects can only be attained by co operation on the part of all concerned, since the infestation occurs throughout all stages of the cacao industry

The problem of insect infestation in stored cacao has three main aspects, namely, (a) in the exporting country, (b) in wharves and warehouses of the importing country, and (c) in the cocoa and chocolate factories of the importing country Cacao insects, for example, may enter the produce in the exporting country and their descendants eventually become transferred to chocolate factories far inland in the importing country This may result in the occurrence of such insects in boxes of manufactured chocolates which may thus reach the consumer Furthermore, certain cacao insects may affect other products stored in proximity to cacao and considerably reduce the value of such products

The chief insects infesting cacao belong to three species The moth *Ephestia elutella* Hb is the most important, and its larvæ attack not only cacao beans but also a great variety of other stored products, including biscuits, figs, chocolate, many kinds of grain, dried fruits, etc It is, consequently, an insect of great economic significance and is very widely distributed The larvæ of another small moth, *Corcyra cephalonica* Staint, are less harmful, since they only occur in small numbers Like the preceding species, it has become widespread, although it was probably originally a pest of rice and has later taken to living on other products The third species is the Anthribid beetle *Aræcercus fasciculatus* De G, the larva of which eat out the endosperm of the cacao beans It is more especially an enemy of nutmegs and only appears to be a serious cacao pest in the Gold Coast

The results of Messrs Munro and Thomson's investigations in London docks and warehouses show that the above species of insects are all found infesting the cacao on arrival from overseas Cacao received from all exporting countries indicates that infestation takes place in those countries, and if remedial and control measures are to be effective they must be carried out at the sources of the trouble In Great Britain it is obvious that whatever measures may be taken to clean up infected buildings, the latter will be liable to become reinfested from fresh cargoes constantly coming in from abroad

Special attention is being given to the *Ephestia* in order to ascertain the life cycle and behaviour of the insect under varying warehouse conditions Its responses to heat, cold, fumigants, and other treatments are being tested, and various experiments have been, and are being, conducted relative to the de infestation of affected buildings where consignments are housed Under present conditions, clean cargoes stored in the warehouses are open to attack, and it is evident that the problem requires concerted action both by the exporting and importing countries These facts are fully recognised, and there is little doubt that now investigations have been initiated, we can look forward to a solution of at least some of the outstanding problems A D I

[1] Report on Insect Infestation of Stored Cacao Prepared for the Empire Marketing Board's Committee on Infestation of Stored Products by J W Munro and W S Thomson (London H M Stationery Office 1929) 1s 6d net

Field Strength in Broadcasting and Receiver Efficiency

IN connexion with the field strength produced at various places by a broadcasting aerial, the paper on signal strength, by J H Reyner, published in the *Journal of the Institution of Electrical Engineers* for January, will be found of interest Measurements were made in Cornwall of the field strength due to the broadcasting station 5XX at Daventry by means of a simple portable equipment consisting of a screened local oscillator and a sensitive micro ammeter

This equipment enabled the actual pressure in millivolts set up in a portable experimental aerial by the radiations from 5XX to be accurately measured The effective height of the aerial being known, it was possible to convert the readings into field strength values in millivolts per metre

The first set of readings was taken at selected points in Cornwall The contour lines obtained seemed to indicate that the coast line was exercising a marked absorbing effect, the field strength at Plymouth and Newquay being only about one-third that at Launceston In the Perranporth district, the field strength on the coast line was only about half that on the hill-top about two miles inland The masts of the Bodmin beam station were visible from the hill top and this suggested that it possibly cast a radio shadow Subsequent experimental results afford strong evidence of this shadow

The region of bad reception extends almost in a direct line from Daventry through Bodmin as far as Redruth, the distance between the latter two towns being about 25 miles Surrounding this area of low signal strength is a ridge of good reception For example, as one goes out towards the coast from Truro, the signal strength first rises on either side and then falls rapidly as the coast line is approached The Bodmin beam station was erected some years ago, but no complaint seems to have been made hitherto of any shadow being cast by it

There is little doubt that with an accurate method of measuring how a radio receiving set fulfils its functions there would soon be a great improvement in their design Now that the field intensity of the radiation from a broadcast station can be readily measured, simple methods of testing sets experimentally will most probably soon be devised

In a paper read to the Institution of Electrical Engineers on Jan 15, H A Thomas, of the National Physical Laboratory, gave a method of measuring the overall efficiency of a receiver The ultimate aim of

all measurements of the constituent parts of a receiver is to obtain the relationship between the input supplied to it and the output it gives This is the most important of the tests, but it is most difficult to obtain accurate results

In making the tests use was made of the screened oscillator cabin at the laboratory, which has a mercury sealed trap door, and the long copper ventilating pipes of which are provided with three copper gauze baffles which screen unwanted radiation completely The apparatus described covers a wave length range from 5 metres to 30,000 metres

The results of tests on four receivers of widely different type are given The experiments show that the overall properties of any receiver can be specified when the input voltage required at a definite modulation percentage to produce a definite standard output signal is known at all wave lengths within the desired range The selectivity of the receiver is the variation of the sensitivity in the neighbourhood of certain fixed wave lengths The distorting properties in the audio frequency stages have also to be measured If it is only desired to determine the range of a receiver with respect to a particular transmitting station, two characteristic curves suffice The work carried out has been done for the Radio Research Board

Fishery Investigations off Iceland

THE Scientific Report of the North Western Area Committee for 1926–27 (Rapport Atlantique, secteur Nord ouest, 1926–27 Conseil Permanent International pour l'Exploration de la Mer May 1929), by Prof Johs Schmidt, contains four papers, the first and fourth on the haddock and plaice respectively, the second and third being shorter papers dealing with bottom faunas, by R Spärk, and the age composition of the stock of cod in East Iceland fjords, by Arni Fridriksson

Dr Harold Thompson's work on the haddock, "General Features in the Biology of the Haddock (*Gadus æglefinus* L) in Icelandic Waters in the Period 1903–1926", and Dr Å Vedel Tåning's "Plaice Investigations in Icelandic Waters", are both of great importance These works deal with the stock on the feeding grounds, age composition, rate of growth, and various biological considerations Both fishes inhabit natural sub areas of the Icelandic plateau For the haddock, two main regions are differentiated, one to the north and east where the coasts are exposed to the polar current, and one to the south and west which is exposed to the warmer Atlantic stream, spawning taking place in this warmer region with a maximum in April, the fish being larger at the same age than those from the north east It is, however, only the bottom stages of the haddock which are here described, as the eggs and larval forms have been fully dealt with by Johs Schmidt (*Cons Internat Rapp et Proc Verb*, vol 10, 1902–7, No 4) The otter trawl is shown to be efficacious and trustworthy for sampling the haddock shoals Growth rates are calculated from the annual zones in the scales

It is assumed, and the assumption is confirmed by biological evidence, that the Icelandic haddock are a self contained stock cut off from interchange with those of other grounds by deep water The first year haddock, the product of the spawning season, like those in the North Sea, probably remain in fairly deep water, later moving nearer the coast for feeding Except the Faroe haddock, those from Iceland grow more rapidly than any in the East Atlantic It is thought that the feeding conditions probably account for this, although so far only a beginning has been made in research of this kind Sand eel is shown to be largely eaten and rapid growth is then effected. The Icelandic haddock spawn at an age of at least one year older than is the case with those from the North Sea

Dr Å Vedel Tåning's work on the plaice deals with spawning and larval forms as well as with the adults Spawning continues from February until May with a maximum in March and April and takes place chiefly in the warmer water of the south and west, the late spawning having a great influence on the rate of growth The maximal growth is found on the western part of the south coast There is a marked decline in the growth along the south coast round to the east coast coinciding with the fall of temperature Temperature and length of summer are shown to be of great importance for the rate of growth in the plaice in Icelandic waters, and probably these factors influence the rate of growth of plaice generally Unlike the haddock, the Icelandic plaice has a higher total number of vertebræ than other known forms, and also varies much in this respect in the Icelandic area itself

University and Educational Intelligence

CAMBRIDGE —The Gordon Wigan Prize in chemistry for 1929 has been awarded to C G Lyons, Trinity Hall, for a dissertation entitled "Thin Films, their Properties and Structure"

Applications for the John Lucas Walker studentship, the holder of which has to devote himself to original research in pathology, are invited and should be sent before July 1 to the professor of pathology The studentship is of the annual value of £300 and is tenable for three years Applications for the Gwynaeth Pretty studentship, the holder of which has to devote himself to original research in the etiology, pathology, and treatment of disease, are also invited, they should be sent before July 1 to the professor of pathology The studentship is of the annual value of £200 and is tenable for three years

The managers of the Nita King Research Scholarship for the encouragement of original research in the etiology, pathology, and prevention of fevers, invite applications from candidates, these should reach the professor of pathology before Feb 28

The governing body of Emmanuel College invites applications for a research studentship which will be awarded in July next Applications (with evidence for a proposed course of research) must reach the Master of Emmanuel College not later than June 30 Preference will be given to candidates who have already completed one but not more than two years of research The studentship has a maximum annual value of £150, and is normally held for two years

LEEDS —M G B Howarth, senior research assistant on the staff of the Joint Research Committee of the Institution of Gas Engineers and the University of Leeds, has been appointed chief chemist to the Newcastle-upon Tyne and Gateshead Gas Company Mr. Howarth was awarded a University scholarship in 1920, and since then has had varied research experience on the works and in the laboratory at Birmingham and Leeds, dealing with blue and carburetted water gas plants, waste heat boilers, aeration of burners, and the products of combustion of gas appliances

'PARENT TEACHER' associations have been at work in the United States for more than thirty years, striving to bring about closer co-operation between home and school No similar movement elsewhere

has attained the volume represented by the member ship roll of a million and a half of the National Congress of Parents and Teachers of the United States, entirely independent, as it is, of State direction In 1927, however, sufficiently widespread interest had been aroused in other countries to justify the organisation of an International Federation of Home and School This was accomplished at Toronto in con nexion with a meeting of the World Federation of Education Associations, the declared object being "to bring together for conference and co operation all those agencies which concern themselves with the care and training of children in home, school, and community, and with the education of parents to meet these responsibilities" Twenty two countries are represented on the board of management, the first action of which was to undertake a survey of the present situation Some of the salient features revealed by reports received from thirty three countries are recorded in an article by the president of the Federation, published in the November issue of *School Life*, the organ of the United States Office of Education From this we learn that next in size and seniority to the American Congress of Parents and Teachers is a West Australian federation, which concerns itself specially with the provision of playing fields and other matters of importance to the physical welfare of school children The movement was introduced into Canada in 1916 and quickly spread from Ontario to other provinces Here, too, special emphasis is laid upon improvement of school con ditions affecting the health of pupils In almost every country of Europe systematic attempts are, it is found, in progress to establish conscious community of purpose and co operation in home and school

THE International Federation of University Women celebrated its tenth anniversary and held its fifth conference at Geneva last August Some five hundred delegates from thirty one national associations were present Among the matters discussed in the course of the proceedings, which lasted seven days, was "The Value of Research" Madame Ramart Lucas from the Sorbonne contributed a survey of "The Creative Effort of the Chemists", and Dr Luise Lammert, who, after a year of study in Australia as holder of one of the Australian university women's fellowships, is working at the Leipzig Meteorological Institute, gave an account of solar radiation observa tions, including her own researches in Australia The Federation's project for the establishment of inter national fellowships has not hitherto met with the encouragement it seems to deserve, the capital, contributed by eighteen associations, amounting to less than £4000, whereas the sum required to endow one fellowship is £5000 The Carnegie Endowment for the Promotion of Peace has marked its appreciation of the Federation's efforts by granting 5000 dollars to be used for travelling expenses Among resolutions adopted at the conference was one providing for assistance in the translation of scientific works A scheme was formulated for utilising and co ordinating for this purpose the linguistic and technical knowledge of the Federation's members In that part of the conference report relating to the work of the various national associations, their activities are described under the following heads encouragement of in dependent research work, stimulation of interest in national and municipal policy, social service, in telligence service, assistance towards finding employment, facilities for social intercourse, educational and cultural work, and other activities The headquarters of the Federation are at Crosby Hall, Cheyne Walk, London, S W 3

Historic Natural Events.

Feb 2, 1282 Severe Winter —Stow records that "From Christmas to the Purification of our Lady [Feb 2] there was such a frost and snow as no man living could remember the like wherethrough five arches of London Bridge were borne downe and carried away by the streame, and the like hapned to many other bridges in England And, not long after, men passed over the Thames between Westminster and Lambeth dryshod" The frozen Thames was used as a highway, and the damage to the bridges was caused by the break up of the ice The winter was also severe in Europe, and at the end of February such heavy snow fell in Austria that many houses could scarcely be seen The melting of the snows caused great floods, and Paris was inundated by the Seine

Feb 2, 1887 Drought —In January 1887 a great area of high pressure lay over Europe, and in February this moved westward over England In London a drought began on Feb 2, the first of 17 consecutive days without rain In March the anticylcone moved still farther west, and until the end of August with few interruptions pressure remained abnormally high over the Atlantic west of Ireland The year 1887 was consequently very dry, over the British Isles as a whole the rainfall was the smallest on record since at least the beginning of the nineteenth century, though in south east England the drought was less severe than in 1921 The level of Lake Derwentwater fell lower than ever previously recorded, at Maresfield, Sussex, threepence a pail was paid for water, and at Langho, near Blackburn water was brought in cans like milk and strictly rationed by the station master

Feb 4, 1579 Snow —Holinshed records that on Feb 4, and the following night "fell such abundance of snow, that in the morning, the same snow was found in London to lie two foot deep in the shallowest and otherwise, being driven by the wind very boisterous in the northeast, banks one ell or a yard and a half deep In the which drifts of snow, far deeper in the country, many cattle, and some men and women were overwhelmed and lost It snowed till the eighth day of that month, and freezed till the tenth, and then followed a thaw with continual rain a long time after, which caused such high waters, and great floods, that the marshes and low grounds being drowned for the time, and the water of the Thames rose so high into Westminster Hall, that after the fall thereof, some fishes were found to remain in the said hall"

Feb 5, 1783 Earthquake —The series of great Calabrian earthquakes beginning on Feb 5 are of interest as the first to be carefully studied There were six great shocks, the strongest being those of Feb 5 and Mar 28 The meizoseismal areas were all small, one town being ruined, while another a few miles away escaped damage Besides being shallow, the focus oscillated to and fro over a distance of 60 miles from Messina to Girifalco By Oct 1786, 1186 after shocks were felt at Monteleone

Feb 5 and 7, 1892 Low Temperature —The lowest temperature ever recorded on the earth's surface was -90° F at Verkhoyansk, Siberia, 200 miles from the mouth of the Lena River

Feb 7, 1921 Drought —From February to October 1921 barometric pressure was above normal over the whole of Europe except the north of Scandinavia, over the United States, and most of Asia These nine months, and the year as a whole, were exceptionally dry over a large part of the northern hemisphere In London, the drought began on Feb 7, and no

appreciable rain fell until Feb 25. The year was not especially dry in Scotland and Ireland, but in England it was the driest since at least the beginning of the nineteenth century, in parts of east Kent the rainfall was less than half the average, and at Margate the total rainfall for the year was only 10 inches In July the flow of the River Thames at Teddington fell to less than one third of the normal July flow In western Europe the drought was equally severe, in Belgium and northern France it was without precedent in historic times, Switzerland and northern Italy suffered severely, and in the Trentino the water of one of the lakes fell so low that a small island appeared for the first time since the great drought of 1806 In Russia the harvest failed, causing wide spread famine and many deaths

Feb 8, 1843 **Earthquake**—By the destructive earthquake of Guadeloupe, Pointe à Pitre, the principal town and port of the island, was reduced to a heap of ruins The shock was felt in Barbados and along the coast of British Guiana, so that the disturbed area must have contained at least one million square miles The wharves of Pointe à Pitre subsided throughout their length, in one place by about a foot

Societies and Academies

London

Royal Society, Jan 23—**Lord Rayleigh** Normal atmospheric dispersion as the cause of the 'Green flash' at sunset, with illustrative experiments (see NATURE, Jan 25, p 144)—**F W Aston** The photometry of mass spectra and the atomic weights of krypton, xenon, and mercury The relative abundance of isotopes can be deduced from the photometry of their lines in mass spectra with sufficient accuracy for a preliminary survey Numerical results are given for the six isotopes of krypton, nine isotopes of xenon, and seven isotopes of mercury The 'isotopic moment' of an element is defined and its value given for these three elements Atomic weight of mercury determined from the abundance results is in good accordance with the accepted value, those for krypton and xenon suggest that those deduced from the densities are about 1 per cent too low—**P A M Dirac** A theory of electrons and protons It is proposed that nearly all the states of negative energy are occupied, so that an electron in a state of positive energy cannot jump into them, by the exclusion principle A state of negative energy that is not occupied may then be identified as a proton, as it will appear to have a positive energy and positive charge (see also p 182)—**R V Southwell** and **L Chitty** On the problem of hydro dynamic stability (1) The paper deals with stability of steady shearing motion in a viscous fluid The method of normal co ordinates appears to be satisfactory for infinitesimal disturbances Within the range of 'Reynolds' number' covered, all normal disturbances have a decreasing time-factor, which depends on Reynolds' number in an extremely complicated way The looped diagrams representing this dependence have no counterpart in ordinary problems of vibration theory—**T E Stern** Some remarks on the conduction of electricity in metals and upon allied phenomena There are two classes of phenomena (1) Those associated with the flow of electricity in closed circuits, to be investigated only by making use of transport theories, and (2) those associated with insulated conductors, to be investigated by general equilibrium theories Various consequences of this difference—such as difference between cooling effects of evaporation of electrons from insulated and from uninsulated conductors—are investigated Special phenomena arising in case of non isotropic conductors are considered—**A Harvey** The Zeeman effect in the band spectrum of helium (2) Estimates are given of magnitudes of (unresolved) Zeeman patterns in He_2 bands of type $^3D \rightarrow 2P\ ^3\Pi$ Effects are widely different for different initial terms $D\epsilon$, $D\pi$, and $D\Delta$, and appear to be closely related to uncoupling of electronic orbital angular momentum L from the inter nuclear axis A few observations on the singlet system were possible, results being generally similar to those for the triplet system

Geneva

Society of Physics and Natural History, Oct 24—**T. Tommasina** Experimental proof, in the heat radiation, of dynamic ultra red rays A double radiometer, revolving in opposite directions, is placed under a triple glass wall, in order to eliminate the direct action of heat With a previously heated pad of cloth, or piece of wood charcoal, coke, or anthracite, there is an immediate rotation of the vanes The author concludes from this that heated black bodies emit penetrating radiations—**R Matthey** The chromosomes of saurians The author has established the chromosome formula of ten species, representing eight families A classification based on the chromosome formula fits in fairly well with modern systematics—**E Briner** and **A Rivier** The chemical action of electric discharges, the influence of the electrodes on the production of nitric oxide by the arc Relying upon electronic theories, more especially on the laws regulating the electronic emission of solid bodies, the authors have realised, using appropriate material for the electrodes, marked improvements in the chemical yield of the electric arc in the fixation of nitrogen in the form of oxide

Nov 7—**E Cherbuliez** and **St Ansbacher** The physiological presence of copper in certain organs in the higher animals A very exact method of estimation has shown the presence of copper in the organs of the higher animals The liver and the spleen are much richer in this element in the newly born than in the adult, in the tuberculous guinea pig the proportion of copper is increased in the liver and reduced in the spleen These facts suggest a hitherto unsuspected physiological rôle for copper—**G Tiercy** Generalisation of the Plantamour method for the measurement of the error of compensation of chronometers The Plantamour method, applied at Teddington, Besançon, and Geneva, has been proposed by Plantamour for the case of three thermal periods The author shows that it also applies in a very simple manner to the case of n periods—**R. Wavre** Complement to the theory of planetary figures The author, by a rigorous and short method, had obtained a system of theoretical relations giving the free surface of fluid stars in slow rotation Wishing to pass from theory to practice, he puts these relations in a form directly utilisable in geodesy, making evident the quantities physically measurable The results obtained suggest that an agreement is possible between the geodesic measurements and the value of a certain constant furnished by the precession of the equinoxes

Leningrad

Academy of Sciences (*Comptes rendus*, No 19)—**E Selivanova** *Coelanthus subtilis* (Tratt) Seidel This grass, known hitherto from a few localities in western Europe, Siberia, and North America, has been found by the author near the river Volchov, in the Novgorod province of European Russia—**P Piatkov** Botanical and soil investigations on Novaya Zemlya, in the area of the polar geophysical observatory 'Matochkin Shar', during 1927–1928 A brief preliminary account of the investigations—**A N Labuntsov** The deposits of molybdenite in the Khibin tundra. A description of the deposits is presented

Official Publications Received.

BRITISH

South Australia Department of Mines Mining Review for the Half year ended June 30th, 1929 (No. 50.) Pp 105+4 plates. (Adelaide Harrison Weir)

The Medical and Scientific Archives of the Adelaide Hospital No. 8 (for the Year 1928). Pp 81 (Adelaide Harrison Weir)

Institute of Industrial Administration Examination Scheme for the Diploma of Industrial Administration December 1929 edition. Pp 16 (London)

Department of Agriculture, New South Wales Veterinary Research Report, 1927-28 (No 5) Pp 124+12 plates (Sydney, N S W Alfred James Kent)

Transactions of the Mining and Geological Institute of India Vol 24 Part 2 December 1929 Pp. 79 222+plates 4 14 (Calcutta.) 4 rupees

Memoirs of the Indian Museum Vol 9, No 4 An Aid to the Study of Hamilton Buchanan's Gangetic Fishes By Dr Sunder Lal Hora Pp 169-192+plates 13 23 2 10 rupees, 4s 9d. Vol 10 The Copepoda of Indian Seas—Calanoida. By Lieut Col R B Seymour Sewell Pp 221 8 2 rupees, 18s 9d (Calcutta Zoological Survey of India)

Records of the Indian Museum Vol 31, Part 4 December 1929 Pp 259 384+plates 12 15 (Calcutta Zoological Survey of India.) 2 12 rupees 5s.

River Moriston Report on River Flow, July to September 1929 By W N McClean (River Flow Records, Ness Basin) Pp 4+3 tables (London River Flow Records) 1s 6d

Torquay Natural History Society Transactions and Proceedings for the Year 1928-9 Vol 5 Part 3 Pp. 175 258+3 plates (Torquay)

Journal of the Royal Microscopical Society Series 3, Vol 49 Part 4, December 1929 Pp. xvi+319 466 (London) 10s net.

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1207 (Ae 368) Wing Flutter as Influenced by the Mobility of the Fuselage By R. A. Frazer and W J Duncan. (T 2677 T 2741 T 2746) Pp 33. (London H M Stationery Office) 1s 3d net.

University College and University College Hospital Medical School London The Second Rickman Godlee Lecture Natural History the Pleasure and Purpose of Observation Delivered by the Rt Hon the Viscount Grey of Fallodon in the Great Hall of the College on Thursday, 7th November 1929 Pp 32 (London University College Publications Secretary) 1s

The Gardens Bulletin Straits Settlements Vol 6 Part 1 December On Chinese Medicine Drugs of Chinese Pharmacies in Malaya. By Dr David Hooper Pp 163 (Singapore Botanic Gardens) 2 50 dollars

Government of India Department of Industries and Labour (Public Works Branch) Irrigation in India Review for 1927-28 Pp 37 (Calcutta Government of India Central Publication Branch) 14 annas 1s 6d

FOREIGN

Proceedings of the United States National Museum Vol 76 Art 11 Revision of the Two-winged Flies of the Genus Coelopa Meigen in North America By J M Aldrich (No 2808) Pp 6 Vol 76 Art 12 Two New Species of Trematodes of the Genus Parametorchis from Fur bearing Animals By Emmett W Price (No 2809) Pp 5 Vol 76 Art 15 New Genera and Species of Muscoid Flies By J M Aldrich (No 2812) Pp 18 Vol 76 Art 20 Notes on the Muscoid Flies of the Genera Opsidia and Opsodexia with the Description of Three New Species By H J Reinhard (No 2817) Pp 9 (Washington D C Government Printing Office)

Report of the Aeronautical Research Institute, Tôkyô Imperial University No 51 Air Flow through Suction Valve of Conical Seat Part 2 Analytical Investigation By Keikiti Tanaka Pp 361 424 0 70 yen No 52 Application of the Inverse Wiedemann Effect to Torque Measurements and to Torque Variation Recordings By Tatuo Kobayasi, assisted by Kinmatu Simamura and Tatuo Koyama Pp 425-435 0 35 yen (Tôkyô Koseikai Publishing House)

Instituts scientifiques de Buitenzorg 's Lands Plantentuin Treubia recueil de travaux zoologiques hydrobiologiques et océanographiques Vol. 11 Livraison 2, Novembre 1929 Pp. 155 300 (Buitenzorg Archipel Drukkerij) 2 50 f

Comité International des Poids et Mesures Procès verbaux des séances Deuxième série Tome 12 Session de 1929 Pp vii+287 (Paris Gauthier Villars et Cie)

Rapport annuel sur l état de l Observatoire de Paris pour l année 1928 Par M Deslandres Pp. 46. (Paris)

Annales de l Institut de Physique du Globe de l Université de Paris et du Bureau Central de Magnétisme terrestre Publiées par les soins de Prof Ch Maurain Tome 7 Pp. iv+218. (Paris Les Presses universitaires de France)

Comité National Française de Géodésie et de Géophysique Section de Magnétisme et Électricité terrestres Nouveau réseau magnétique de la France au 1er janvier 1924. (Extrait des Annales de l Institut de Physique du Globe de l Université de Paris tome 7) Pp. 45 (Paris Les Presses universitaires de France)

Ministry of Public Works, Egypt Physical Department. Meteorological Report for the Year 1925. Pp. xiii+168 (Cairo Government Press) 40 P T

Journal of the Faculty of Science, Imperial University of Tokyo Section 1 Mathematics, Astronomy, Physics, Chemistry Vol 1 Part 12. Pp. 439 480+plates 36-39 1 20 yen Section 4 Zoology Vol 2, Part 2 Pp. 51 139+plates 9 11 2 30 yen Section 2 Geology, Mineralogy, Geography, Seismology Vol 2, Part 9 Pp. 369 396+plates 71 76 1 10 yen Vol 3, Part 1 Pp vi+28+4 plates 1 00 yen Vol 3 Part 2 Pp 29-129 1 90 yen. (Tokyo Maruzen Co., Ltd)

Smithsonian Institution United States National Museum Bulletin 100 Contributions to the Biology of the Philippine Archipelago and Adjacent Regions Bryozoa of the Philippine Region By Ferdinand Canu and Ray S Bassler Pp. xi+685+94 plates (Washington, D C Government Printing Office.) 1 75 dollars.

Annual Report of the Naval Observatory for the Fiscal Year 1929 (Appendix No. 2 to Annual Report of the Chief of the Bureau of Navigation, 1929) Pp iii + 37 (Washington, D C Government Printing Office)

United States Department of Commerce Bureau of Standards Bureau of Standards Journal of Research Vol 3, No 5 November 1929 Pp 619 827 (Washington, D C Government Printing Office)

The University of Chicago. Publications of the Yerkes Observatory Vol. 7 Part 1 Radial Velocities of 500 Stars of Spectral Class A By Edwin B Frost, Storrs B Barrett and Otto Struve. Pp vii+79 (Chicago University of Chicago Press London Cambridge University Press)

Verhandlungen der Schweizerischen Naturforschenden Gesellschaft 110 Jahresversammlung vom 29 August bis 1 September 1929 in Davos. Pp 144+236+44 (Aarau H R. Sauerländer et Cie)

CATALOGUES

Catalogue of Scientific Books and Publications of Learned Societies. (No 340) Pp 110 (Cambridge W Heffer and Sons, Ltd)

Watsons Microscope Record No 19 January Pp 32 (London W Watson and Sons Ltd)

The Sanbro Laboratory Oven Pp 8 (London Brown and Son Ltd)

Diary of Societies.

FRIDAY JANUARY 31

DIESEL ENGINE USERS ASSOCIATION (at Caxton Hall), at 3 30 —W S Burn High powered Oil Engines for Land Purposes

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion) at 4 30 —Seismic Methods in Surveying Prof A O Rankine Dr H Jeffreys, Capt Shaw R S Whipple, F J W Whipple Chairman Prof H H Turner

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Prof W S Handley The Papilloma and its Menace

INSTITUTION OF ELECTRICAL ENGINEERS (London Students Section), at 6 15 —R R Poole Practical Television

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section) at 7

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (Joint Meeting) (at Newcastle upon Tyne), at 7 15 —W G Thompson The Electrical Propulsion of Ships

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section jointly with other Chemical Societies of Glasgow) (at 39 Elmbank Crescent, Glasgow), at 7 30 —Prof I M Heilbron Our Present Knowledge of the Fat soluble Vitamins A and D

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting) at 7 30 —F Onions Superheating

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Lord Rayleigh Iridescent Colour in Nature

INSTITUTION OF ELECTRICAL ENGINEERS (West Wales (Swansea) Sub Centre)

SATURDAY FEBRUARY 1

BRITISH MYCOLOGICAL SOCIETY (at University College) at 11 A M —D B Barnes Induced Variations in *Thamnidium elegans* —Prof W Brown Investigations on the Physico chemical Basis of Disease Resistance —Dr I Reichert Infection of *Fungi* with *Tilletia* —Dr G Samuel The Generic Names *Alternaria* and *Macrosporium*.—Dr H S Vasudeva The Effect of one Organism in Reducing the Virulence of Another

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College for Women) at 3 —Annual Meeting

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —Prof R W Chambers Sir Thomas More and his Friends (2).

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch) (at Yeovil) —The Westland Wapiti in Service.

MONDAY, FEBRUARY 3

ROYAL SOCIETY, EDINBURGH at 4 30 —R W Wrigley On Changes of Rock Temperatures and Irregularities of the Earth's Rotation —S Williams The Morphology of *Tricuspidaria ophlebioides* Christ with Special Reference to the Aphlebioid Leaves —J S. Patel On the Existence of a Kyogenic Substance in the Corpus Luteum —Pius Koller Genetic Studies of the A and B Races of *Drosophila obscura* – Prof F A E Crew and Dr L Mirskaia Maturity in Albino and Coloured Mice —A. Mozley Report of the Jasper Park Lakes Investigations 1924-26 The Mollusca of Jasper Park

VICTORIA INSTITUTE (at Central Buildings Westminster) at 4 30.—Rev Dr W M Christie Jew and Arab in Palestine

ROYAL INSTITUTION OF GREAT BRITAIN at 5 —General Meeting

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 - Prof G Keynes The Radium Treatment of Carcinoma of the Breast.

SOCIETY OF ENGINEERS (at Geological Society) at 6 —W M Beckett Presidential Address

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 6 —Miss Evelyn Lawrence An Investigation into the Relation between Intelligence and Inheritance

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7 —H G S. Peck and others Discussion on Maintenance of Telephone Plant

UNIVERSITY OF BIRMINGHAM MEDICAL SOCIETY, at 8 —Prof J C Brash The Surgeon Anatomist and the History of Anatomy (William Haslam Oration)

ROYAL SOCIETY OF ARTS, at 8 —H J L Wright Three Master Etchers Rembrandt Meryon, Whistler (Cantor Lectures) (3).

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Institution of Mechanical Engineers), at 8.—Dr H Levinstein Chemical Disarmament.

TWICKENHAM LITERARY AND SCIENTIFIC SOCIETY (at Free Library, Twickenham), at 8.—Capt. R. S. Gwatkin Williams: In the Hands of the Senussi.

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at the Abbey Hall, Plymouth).—Capt. P. P. Eckersley: Broadcasting by Electric Waves (Faraday Lecture).

INSTITUTION OF THE RUBBER INDUSTRY (London and District Section) (at Engineers' Club, Coventry Street, W.1).—B. B. Evans: The Sun cracking of Vulcanised Rubber.

TUESDAY, FEBRUARY 4.

ELECTRICAL ASSOCIATION FOR WOMEN (at 15 Savoy Street, W.C.2), at 3.—G. S. Francis: Plastic Lighting and Modern Architecture.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. F. W. Aston: Isotopes (3).

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 5.30.—Clinical Meeting.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—The Secretary: Report on the Additions to the Society's Menagerie during the months of November and December 1929.—E. Hollis: Exhibition of Skin of a Hen Pheasant showing Male Plumage.—J. Omer-Cooper: A Preliminary Investigation of the Fresh-water Fauna of Abyssinia.—Prof. S. J. Hickson: Report on the Hydras collected by Mr. J. Omer-Cooper in Abyssinia.—A. G. Lowndes: Freshwater Copepoda from Abyssinia collected by Mr. J. Omer-Cooper.—H. W. Parker: Report on the Amphibia collected by Mr. J. Omer-Cooper in Abyssinia.—Prof. S. J. Hickson: (*a*) On the Classification of the Alcyonaria. (*b*) Some Alcyonarians from the Western Pacific Ocean.—C. Ping: On the Cerebrum of *Felis t. gris*.—A. Loveridge: A List of the Amphibia of the British Territories in East Africa (Uganda, Kenya Colony, Tanganyika Territory, and Zanzibar), together with Keys for the Diagnosis of the Species.

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (jointly with Hull Chemical and Engineering Society) (at Great Northern Station Hotel, Leeds), at 7.—Discussion on Fuel: Boiler Firing with Pulverised Fuel, H. Wheldon: Gaseous Fuel, B. Stonham: Boiler House Theory and the Medium Sized Works, G. H. Whyatt.

INSTITUTE OF METALS (Birmingham Section) (at Chamber of Commerce, Birmingham), at 7.—J. McNeil: Nickel Casting Alloys.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—W. A. Clark: A London Pilgrimage.

INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (Informal Meeting) (at Lamb's Restaurant, Dundee), at 7.30.—Discussion on Curious Faults and Experiences.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7.45.—Prof. B. P. Haigh: The Relative Safety of Mild and High-tensile Steel under Alternating and Pulsating Stresses.

TELEVISION SOCIETY (at Engineers' Club, Coventry Street, W.1), at 8.—G. P. Barnard: The Photoconductivity of Selenium and various other Substances.

INSTITUTION OF ELECTRICAL ENGINEERS (North Western Centre) (jointly with Institution of Post Office Electrical Engineers).—S. S. A. Watkins: Talking Films.

WEDNESDAY, FEBRUARY 5.

ROYAL SOCIETY OF MEDICINE (History of Medicine Section), at 5.—F. Prescott: Spallanzani on Spontaneous Generation and Digestion.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. J. H. Fisher: Some Points in Connexion with Perforating Injuries of the Eyeball.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Prof. E. J. Garwood: The Tuedian Beds of Northern Cumberland and Roxburghshire east of the Liddelwater.—Sir Douglas Mawson: Pre-Ordovician Rocks of the McDonnell Ranges (Central Australia).

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section) (at City and Guilds Engineering College), at 6.—Short Papers on New Developments.

GLASGOW UNIVERSITY ALCHEMISTS CLUB (at Glasgow University), at 7.30.—Prof. A. Hunter: The Nature and Action of Hormones.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—R. L. Andrew: The Determination of Minute Amounts of Iodine in Soils and Waters.—Dr. D. W. Kent-Jones and A. J. Amos: Preliminary Studies in the Bacteriology of Wheat and Flour.—Dr. H. J. S. Sand: The Separation of Metals by Internal Electrolysis.—Ella M. Collin: The Rapid Determination of Bismuth and Copper in Lead Bullion by Internal Electrolysis.—G. W. Leeper: Notes on the Thiocyanate Method of Determining Iron: Influence of Different Classes of Phosphates.

ROYAL SOCIETY OF ARTS, at 8.—Sir William Clare Lees: Some Aspects of the Question of Trade with South America.

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

ROYAL SOCIETY OF MEDICINE (Surgery Section), at 8.30.—T. Edwards, W. H. C. Romanis, Dr. L. S. T. Burrell, and Dr. F. G. Chandler: Discussion on Intra-thoracic Tumours.

INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough).

ROYAL MICROSCOPICAL SOCIETY (Biological Section).

THURSDAY, FEBRUARY 6.

ROYAL SOCIETY, at 4.30.—*Probably to be read*:—Prof. S. Chapman: A Note on the Measurement of the Specific Heats of Gases.—L. M. T. Gray and D. W. G. Style: The Absorption of Light by Chlorine, Bromine and their Gaseous Mixtures.—A. H. Davis and E. J. Evans: Measurement of Absorbing Power of Materials by the Stationary Wave Method.

LINNEAN SOCIETY, at 5.—Prof. R. R. Gates: Vegetation of the Mackenzie River Valley.—Dr. G. P. Bidder: The Importance of Cataclasma in Evolution.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—J. Hodgkinson: Conformal Representation by Means of Lamé Functions.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. R. L. Smith-Rose: Radio Direction Finding by Transmission and Reception.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—J. W. Maccoll: Modern Research in Germany.

SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section) (Annual Meeting) (at University College, Nottingham), at 7.10.—At 7.30.—C. F. Hammond: The Application of Submerged Combustion to the Dyeing, Laundry, Chemical and Allied Industries.

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (at Bristol University), at 7.30.—J. D. Pratt: Rationalisation.

CHEMICAL SOCIETY, at 8.—Prof. A. J. Allmand and D. W. G. Style: The Photolysis of Aqueous Hydrogen Peroxide Solutions. Part I. Experimental Methods. Part II. Experimental Results.—Miss R. V. Henley and E. E. Turner: The Scission of Diaryl Ethers and Related Compounds by Means of Piperidine. Part III. The Nitration of 2:4-dibromo-2′:4′-dinitrodiphenyl Ether and of 2:4-dibromophenyl *p*-toluene-sulphonate and Benzoate. The Chlorination and Bromination of *m*-nitrophenol.

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch) (at Yeovil).—D. B. Nivison: Aircraft Production Methods.

FRIDAY, FEBRUARY 7.

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4.30.—G. H. Tipper: Recent Mineral Developments in India.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir John Rose Bradford: Massive Collapse of the Lung.

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—S. S. Cook: High Pressure Steam for Marine Work.

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Chamber of Commerce, Birmingham), at 6.30.—A. G. Lobley: Electric Furnaces for Heat Treatment.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Institute of Fuel) (at Engineers' Club, Manchester), at 7.—Prof. M. W. Travers: The Fundamental Problems of Flue Gas Purification.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—G. F. Shotter: A New Null Method of Testing Instrument Transformers and its Applications.—R. J. S. Spilsbury and Dr. A. H. M. Arnold: Some Accessory Apparatus for Precise Measurements of Alternating Current.—Dr. A. H. M. Arnold: Precision Testing of Current Transformers.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—Practical Evening.

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.—W. G. Thompson: The Electrical Propulsion of Ships.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—G. F. O'Riordan: Co-operation between Technical Institutions and Industry.

GEOLOGISTS' ASSOCIATION (Annual General Meeting) (at University College), at 7.30.—Presidential Address: The Geological Life Work of Sydney Savory Buckman.

PHILOLOGICAL SOCIETY (at University College), at 8.—Prof. V. G. Childe: Philology and Archæology.

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.—C. L. Hewer and I. W. Magill: Discussion on Anæsthesia in Thoracic Surgery.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. L. Hill: Diving.

SATURDAY, FEBRUARY 8.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Rev. G. Cooke: Tonality and Form.

MINING INSTITUTE OF SCOTLAND (at Edinburgh).

PHYSIOLOGICAL SOCIETY (at St. Bartholomew's Hospital Medical College).

PUBLIC LECTURES.

SATURDAY, FEBRUARY 1.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—D. Martin Roberts: London in the Tudor Age.

TUESDAY, FEBRUARY 4.

GRESHAM COLLEGE, at 6.—Sir George Newman: Physic. (Succeeding Lectures on Feb. 5, 6, and 7.)

WEDNESDAY, FEBRUARY 5.

LONDON SCHOOL OF ECONOMICS, at 5.—R. J. Thompson: Economic Research in Agriculture—Its Bearing on the Supply of Food and Raw Materials.

UNIVERSITY COLLEGE, at 5.—Dr. R. J. Ludford: Cytology in Relation to Physiology and Pathology. (Succeeding Lectures on Feb. 12, 19, 26, Mar. 5 and 12.)

KING'S COLLEGE, at 5.30.—Prof. H. J. Rose: Methods of Research in Classical Mythology. (Succeeding Lectures on Feb. 6 and 7.)

AT 40 TORRINGTON SQUARE, at 5.30.—N. B. Jopson: The Early Civilisation and History of the Slave. (Succeeding Lecture on Feb. 12.)

BELFAST MUSEUM, at 8.—C. E. Kerr: Ulster Place Names.

THURSDAY, FEBRUARY 6.

KING'S COLLEGE, at 5.—C. J. Gadd: The Jews under the Persian Empire.

FRIDAY, FEBRUARY 7.

UNIVERSITY OF LEEDS, at 8.—Prof. Blanchard: Human Geography and the Methods of teaching Geography.

SATURDAY, FEBRUARY 8.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Ancient Egyptian Jewellery.

CONFERENCE.

WEDNESDAY, FEBRUARY 5.

GRASSLAND CONFERENCE (at Harper Adams Agricultural College, Newport, Salop), at 2.—Dr. J. A. Hanley, W. B. Mercer, and R. Boutflour: Addresses on the Formation, Maintenance, and Utilisation of Temporary and Permanent Pastures.

SATURDAY, FEBRUARY 8, 1930

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Editorial and Publishing Offices

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Research and Finance in the Study of Man and his Past

IN a note which appeared in NATURE of Feb 1, p 175, the announcement of the departure of the British Museum's expedition to British Honduras for the purpose of continuing the excavation of Mayan antiquities is coupled with a reference to an appeal by the Director of the Museum for funds to carry on the work and to ensure its continuation It is held out as an inducement to subscribers, that the sites on which these investigations are being made are within imperial territory, and that this fact gives to British archæologists a security of tenure which they are unable to secure on any prehistoric site in the old world That this is an element in archæological research of no little importance is indicated by the recent removal of the operations of the British School of Archæology in Egypt to Palestine, as well as by the experience of those who have continued to work in Egypt since changed conditions have prevailed Even the intensely interesting archæological field which is opening up in India along the Indus Valley is not likely to offer rival attractions to Honduras in this respect, while at any rate investigation on important sites is primarily a function of the Archæological Survey The Schools of Archæology in Iraq and Palestine operate in mandated territory, while those at Athens and Rome are naturally entirely subject to the regulations for the time being of their hosts They may at any moment find their activities restricted, as happened in Greece a few years ago when the operations of foreign schools of archæology were limited to two sites in any one year The expedition to British Honduras, therefore, it is justly claimed, enjoys a unique advantage in that it is working entirely within the boundaries of British territory

We wish the Director's appeal every success, but while commending it strongly as in every way calling for the generous support of the public, it is in no spirit of criticism that we point out that it inevitably gives rise to a variety of reflections It may be said without undue partiality that British field work in archæology has proved itself second to none in scientific methods of excavation and in the accurate and painstaking recording and preservation of results Yet while our archæologists are to the fore in every field in the Old World, the New has been sadly neglected Students in Britain of the archæology and cultures of America—North, Central, and South—are a small, if distinguished, body. If, however, there is one man who played the

greatest part in establishing the modern study of Central American archæology, it is an Englishman, Dr A P Maudslay, whose remarkable journeys of exploration brought back from the Central American forests, surmounting almost incredible difficulties, a wonderful series of plaster casts of Mayan antiquities which were afterwards presented to the nation

The magnitude of this work has never been generally appreciated The density of vegetation in the tropical forest made it a work of intense endurance even to reach the ruins and to clear them from the vegetation with which they were covered , but apart from that, every ounce of the plaster of Paris used in making these large casts was imported from England and carried by the expedition to the sites on which it was used The total cost borne by Dr Maudslay himself was at least £10,000, while the labour and time involved by his expeditions will be appreciated when it is remembered that Capt Joyce's expedition to Pusilhá in 1929 with the aid of a motor tractor took eighteen days to cover a distance of 48 miles by land and river For Honduras that was good progress The whole way on land had to be cut through thick vegetation

With a record of this character behind us in Americanist studies—without reference to the valuable contribution made by Capt Joyce, both in his synthetic studies of American archæology and his original investigations—it seems incredible that the opportunity should be neglected The attention of British archæologists should be attracted to a study of such interest and importance A British school of American archæology should be built up to explore our own territory in Central America The fields of the Old World offer an attraction which cannot be denied They are beginning to link up the history of civilisation as a whole in time and space in a manner in which American archæology in its present isolation, apart from diffusionist views, cannot hope to do The development of scientific method on Old World sites makes them admirable training grounds for the student , but American archæology presents its own problems in method, and it must be remembered that even here stratigraphical problems have to be solved even if the conditions differ, as can be seen in the work of American archæologists in the South-Western States, in Mexico Valley, and in some of the other recent investigations in Central and South America

Further, in Central America it is difficult to forecast what the future may bring forth, for investigation has still to demonstrate with certainty the beginnings of this culture The opportunities for discovery seem to be practically unlimited The short trial aeroplane flight made from Belize recently by Col Lindbergh showed how many unknown ruins it was possible to sight in an area relatively restricted When once the facts of the case are appreciated, they require no emphasis to press the need for the formation of such a school, perhaps on the lines of Sir Flinders Petrie's Egyptian school rather than of those at Athens and Rome The British Museum's expedition, if placed on a permanent basis, might form its nucleus It would be a graceful recognition of a great piece of work, which is a credit to British archæological studies, if it could in some way be linked with the name of Dr Maudslay

These matters, however, lie with the future The British Museum's appeal is of the present The British Museum appeals for funds for an expedition of exploration in a British Colony ! In other words, a great national institution has to appeal to the generosity of the private individual to carry out work which its administration has decided is within its province and for which members of its own staff have been seconded In this year's expedition the experienced and exceptionally qualified leader is unable to participate, owing, it is presumed, to his official duties as Deputy Keeper , and part of the funds are derived from the generous gift of an American For this gift we are grateful, but an expedition so essentially British should be able to rely if necessary upon British money

The case of the Honduras Expedition is not singular The excavations at Ur, which have produced results epoch making in their revelation of the early history of civilisation, have also been carried out by an expedition of the British Museum , but although the Museum authorities were well aware of the importance of the site, they did not feel justified in entering upon the financial responsibilities involved by its excavation until a joint expedition was proposed by the Museum of the University of Pennsylvania Three seasons ago the excavation had to close down prematurely for lack of funds at a most important stage of its work, when the possibility of disturbance during the summer endangered the most momentous discoveries ever made on the site, as was shown immediately the work reopened in the following season

It scarcely calls for argument that work which is considered sufficiently important to be carried on under the ægis of a national institution such as the

British Museum should not depend for its continuity upon the precarious generosity of the private individual. Such investigations are not undertaken with undue frequency, or without careful consideration of their intrinsic importance and their moment in the general advancement of knowledge. If they are undertaken, it is surely beneath our dignity that the Director should be in such a position that he must appeal to the individual citizen, or even to a foreign benefactor, to provide the funds to carry out what it has been decided after due consideration is a proper function of a national institution.

The Royal Commission on Museums and National Galleries has reported with admirable moderation and discretion; but it has shown that our national collections have been starved. The Report recognises the nation's indebtedness to the private benefactor in the past; it hopes that we may still rely upon the generosity of the individual in the future. Archæological exploration, however, is too often a matter of immediate opportunity, both in site and personnel, to depend upon fortuitous finance. It would be an excellent thing if a commission similar to that on the Museums were appointed to examine the question of State assistance to scientific research in general. Some provision is already made out of national funds for certain branches of research; but the benefits of this provision are practically confined to the physical sciences.

How much is done for the humanistic sciences? What funds are available for anthropology? A line has been drawn at physical anthropology, while the amounts available for archæology from the grants allocated by the Royal Society are, as a rule and relatively, almost negligible. It has been pointed out again and again that, through a lack of funds, enthnographic material within the Empire is being allowed to disappear rapidly as our primitive peoples come into contact with European culture. Archæological material is perhaps in better case; but if so, this is due to private benefaction and a greater interest taken in the subject by the public, who are sometimes prepared to give practical expression to that interest in the form of a subscription. Even so, financial resources are precarious and often inadequate.

The success of the appeal for a School of Archæology in Iraq was almost entirely a success of the personality of the late Miss Gertrude Bell. The appeal of the British School of Archæology in Palestine failed utterly, and that too at a time when the Government had withdrawn its temporary financial support. Here, however, if anywhere, might archæology have looked for sympathy and assistance from the public when it was engaged in investigating the early history of that country in which so many of our religious and intellectual antecedents are rooted. Palestine is the chief spiritual fount of the British peoples, but it is not the only one. We have British schools in other countries to which our civilisation is almost as deeply indebted. The schools at Athens and Rome have been generously supported by subscription and benefaction, but their means have been and continue to be inadequate to carry out fully the programme of instruction and research they have set themselves. Further, in each case they represent the British nation in almost an equal degree with the British Embassy. They provide an intellectual and academic, as well as a social, centre representative of the British nation, for visitors and residents alike. That their work should be endangered or restricted for lack of funds does us as a nation no credit.

The question of the subvention of research in humanistic studies from public funds opens up a wide field upon which it is not possible here to do more than touch. The archæology of Great Britain itself, for example, has its no less urgent needs. While claims on the public purse are many and the country is overburdened with taxation, a plea from any one department of knowledge may easily be set aside as inopportune on grounds of public policy. It is for this reason that for a reasoned verdict on the urgency of the plea we should look to a public inquiry into the present needs of research, especially in the humanistic sciences.

Mendelism and Anthropology

Heredity in Man. By Prof. R. Ruggles Gates. Pp. xiii + 385. (London: Constable and Co., Ltd., 1929.) 24*s.* net.

A BOOK with a title "Heredity in Man" will attract the attention of the many who are interested in human affairs, and who have been made aware of the proven usefulness of the contributions of the science of genetics to the practices of animal and plant breeding.

It will appeal strongly to such as hold the view that the further evolution of man, and therefore of society, will take the form of the conscious and deliberate manipulation by man of the attributes of his environment and of the mechanisms that are himself. These will agree with the statement in the preface that a knowledge of human heredity

must form the basis of any enlightened attempt to influence the future development of the human race This is the point of view of the ardent eugenist, who would seem to advocate the application of stock breeding practices for the prevention of the continued existence of undesired types

The book will be read by the student of political science as well as by those politicians, professional and amateur, who, nowadays, so eagerly seek biological endorsement for their own peculiar prejudices To day it is not uncommon, when the politician speaks, to hear the views of some biologist If, for example, in a country, changing economic and political circumstances make it desirable on the part of those presently in power to limit the numbers of immigrants from countries where a lower standard of living and different habits and manners obtain, the official reason that is commonly given in explanation of such an attitude and for such a policy is one that is based on the teachings of those biologists who preach the view that certain races or racial types are genetically superior

Reading this book, the eugenist who seeks encouragement for policies of a positive kind, and the politician who seeks an authority that he may quote, will be disappointed, for Prof Ruggles Gates avoids discussion of the implications of genetic fact, contenting himself with the presentation of what has been said and what has been thought, and leaving the task of weaving these facts into considered policies to other people, probably less able than himself

The book will be read by the physician who seeks an answer to the question now frequently put to him, 'Should we two with such and-such family histories, or with such and such personal disabilities, marry and have children ?' It is true that now the domination of bacteriology in medicine is waning, medical practitioners are studying much more thoroughly the rôle of inheritance in the etiology of disease, and that this new and intensified interest is revealed in the quality of their writings But though the doctor will find in this book a very complete compilation of what has been recorded and of what has been said of the mode of inheritance of physical defect and derangement, he will probably decide that the author too frequently goes beyond the human subject for his examples—there are at least a hundred references to inherited characters in animals other than man—and he will certainly find that in a very great many instances of such inherited abnormality he can obtain nothing that will help him to answer categorically the question that is asked. This, unfortunately, must necessarily be so, for the majority of the records of family histories have been taken by such as have been untrained in genetical methods and relate all too commonly to individuals introduced solely through anecdote But even though Prof Ruggles Gates advises but rarely, as when, for example, he states, quoting Macklin, "13 per cent of pupils in blind schools are blind through cataract They should obviously not have children ", such facts as are known are fairly given, and these will permit the physician himself, having read the book, to present a reasonable opinion

It is accepted that, socially, the inherited physical defects and derangements are not so important as are the mental The reason for this would seem to be that a greater proportion of the physical are either curable or are of a kind that do not seriously handicap their exhibitors in competition with their fellows The fact that polydactyly is inherited is of interest and of scientific importance, but no one would advocate legislation which would deny parentage to the polydactylous The condition does not seriously handicap its exhibitor, and, in any case, the extra digit in each succeeding generation can be cut off Red green blindness is an inherited character, and unless parentage is denied to such as carry in their hereditary constitutions the factors responsible, it will spread slowly but surely through a population But although it cannot be cured, it is not, in present circumstances, a serious handicap It can therefore be disregarded It is only when a defect is incurable and when it renders its exhibitor unable successfully to compete with his fellows that it constitutes a problem The simplest method of solving this would of course be to find a cure, and doubtless, as time passes, advances in medical science will give to mankind the power to repair hereditary deficiencies and to prevent many forms of genetic defect

Since most of the inherited and undesirable mental characters are presently incurable, since we do not know the chemistry of normality, and because they render the individual a burden to himself and, more particularly, to his fellows, they constitute a very serious social problem For example, Prof Ruggles Gates quotes Goddard, who states that 50 per cent of all paupers and of all prostitutes are feeble minded, and accepts the statement that feeble mindedness is, in the majority of instances, an inherited character, behaving as a simple Mendelian recessive Here again Prof

Ruggles Gates studiously avoids any discussion of the implications of this statement Surely, if it is accepted that feeble-mindedness is commonly a hereditary character, behaving in inheritance as a simple recessive, the methods to be adopted to prevent the multiplication of such stocks are obvious Surely it is reasonable that those who read a book such as this should expect therein a statement of the views of the author concerning such a matter as this Possibly, Prof Ruggles Gates is of the opinion that it is the task of the biologist to present the facts, and not for the biologist alone to discuss policies based on these facts Many will agree with this view But the biologist to day cannot refuse to make his contribution toward the construction of policies that affect mankind It is probable that Prof Ruggles Gates holds the view that before the biologist can advise action he must be in possession of all the pertinent data The fact that only some 30 pages out of a total of some 380 are devoted to a discussion of mental characters in man will show how very little is known of those normal and abnormal characters which are so important socially

It is only as one approaches the end of the book that one realises that Prof Ruggles Gates's interest in human heredity is directly related to his activities as an anthropologist Throughout the book he neglects the interest of the politician, the physician, and the eugenist, though he continually refers to matters of profound interest to them, and for the reason that undoubtedly he is addressing himself to the anthropologist He treats the subject of racial crossing mainly from this angle, and discusses all too briefly the general policy of such intermixtures From the very insufficient and haphazard crosses that have been made he concludes—as would be expected from one with genetical knowledge—that the melting pot conception is now discredited, and that segregation of independently inherited characters occurs even after thousands of years

It is entirely satisfactory to know that through such a book as this the genetic point of view will be introduced into anthropological literature, and there is no doubt that in writing this book Prof Ruggles Gates has rendered great service But anthropologists are few, and politicians, physicians, and eugenists are many, and it is to be hoped that Prof Ruggles Gates will now address the large audience that awaits him. The geneticist has contributions of the utmost importance to make, and it is highly desirable that we should know what Prof Ruggles Gates, as a geneticist, has to say upon such questions as, for example, the effect of emigration and immigration upon the Scottish stock, the worthiness of our present information concerning feeble mindedness, the validity of the argument concerning racial genetic superiority There are scores of questions such as these that are puzzling the minds of those who are guiding the destinies of Great Britain, and they can only be answered when the biologist has made his contribution

Having read the book carefully, one suffers from a feeling of regret that the author has quoted the opinions of others so much and presented his own so infrequently, for, without doubt, Prof Ruggles Gates can bring to the discussion of this subject of human heredity, fresh points of view that would be exceedingly stimulating F A E CREW

Science and Art of Lubrication

The Principles and Practice of Lubrication a Manual for Petroleum Technologists, Students, Engineers, Oil Salesmen, etc By Prof Alfred W Nash and Dr A R Bowen Pp xi + 315 + 29 plates (London Chapman and Hall, Ltd, 1929) *15s* net

IN the opinion of the authors, lubrication is no longer an art, for to secure efficiency it is now necessary to understand the scientific principles upon which the proper choice of lubricating oils and greases depends, and also the laws upon which the proper design of bearings is based Engineers in the past have had to rely wholly upon their practical experience when dealing with lubrication problems, but of recent years scientifically conducted experiments have shown what the actual conditions are under which lubricated bearings run One of the most satisfactory features of such research work has been that whilst engineers interested in lubrication problems are more inclined to study the teachings of scientific discovery, scientific workers are more desirous of assisting the practical man to ascertain the causes of the difficulties met with in practice, with the result that it is now possible to produce a manual, such as the one we are considering, dealing with the subject rather as a science than as an art However, it must not be forgotten that, although much has been accomplished, there remain some peculiar frictional phenomena which cannot be satisfactorily accounted for

The practice of lubrication is essentially the interposition between two surfaces in rubbing contact, of some fluid or soft solid, which will sufficiently reduce the frictional resistance to prevent

them from heating and injuring each other The various types of friction are treated of in Chap ii, and are classified under two headings as follows

UNLUBRICATED SURFACES

(a) *Dry Friction*—This represents friction between perfectly clean, dry, solid surfaces

(b) *Rolling Friction*—A term applied to such reactionary force as is found between solid surfaces separated by balls or rollers

LUBRICATED SURFACES

(c) *Boundary Friction*

(d) *Fluid Friction*

In the case of fluid friction the surfaces are entirely separated from each other by a comparatively thick film of the lubricant Beauchamp Towers' experiments on journal friction are clearly described, as also are the investigations of Osborne Reynolds concerning the cause of the separation of the shaft and bearing surfaces by a film of oil under pressure When the rubbing surfaces are flat they separate only slightly, and a comparatively thick fluid film does not form Michell's method of causing such a thick lubricating film to accumulate is figured and described The coefficient of friction of bearings resting upon such viscous films is very small, so small indeed that the heat developed by friction escapes freely by conduction and convection, and there is no undue rise of temperature The authors, however, point out that, as evidenced by wear, very few bearings in practice can be working at all times under conditions of complete fluid friction, as there is no wear when such conditions prevail On this account all bearings, even when they have been designed so that they are in most conditions of running separated by a lubricating viscous film, must be supplied with an oil which has a low coefficient of static friction, so as to keep them cool when boundary conditions of friction supervene

Boundary friction receives a good deal of attention from the authors, the experimental work of Sir William Hardy and others being cited When viscous liquids or greases are spread over surfaces in rubbing contact, the resulting threshold or static friction is not found to bear any regular relationship to the viscosity of the lubricant, except when members of chemical series, such as the paraffins or alcohols, are contrasted the one with the other Engineers have always recognised this, and have regarded as lubricants only those liquids with small threshold frictions Thus, quite apart from its viscosity, a liquid, to be a good lubricant, must possess marked 'oiliness' Clean solids in rubbing contact also have widely different threshold frictions, that is, they vary in 'unctuousness' In practice the lowest frictions are obtained by using solids for the rubbing surfaces which have marked unctuousness, with lubricants of marked oiliness

Specific gravity and viscosity are dealt with in Chap iii, methods for their determination being described, and apparatus illustrated

In Chap iv the design and lubrication of bearings are discussed As both animal and vegetable lubricants possess the property of oiliness much more markedly than mineral oils, the authors consider that the importance of the property of unctuousness in bearing metals cannot be overestimated, a good bearing metal often enabling a moderately oily lubricant to work satisfactorily Indeed, this chapter is sure to prove useful to the engineer

Chap v deals with the source, methods of manufacture, preparation, and composition of lubricants, as well as their compounding and blending In the following two chapters the chemistry and the chemical and physical testing of lubricants are considered Here (p 191) the authors rightly remark "It has already been pointed out that the best judgment of the value of an oil is made from a test in the machinery for which it is intended, such a test can constitute the only reliable guide to the durability and lubricating value of the oil However, there are certain chemical tests which should be made before the oil reaches the engineer, and these tests, although not deciding the lubricating power, give important information upon the degree of refining of the oil, its mineral, fatty, or compound nature, and also the impurities or adulterants"

The mechanical testing of lubricants in special machines is considered in Chap ix Mechanical friction tests being the only fair means of ascertaining the lubricating value of oils, they are most satisfactorily made by using one or other of the many forms of mechanical oil testing machines which have been devised to reproduce as closely as possible the conditions met with under various practical conditions of work Thus we have here described machines for determining unctuousness and oiliness, and others for conditions when these and viscous film conditions are combined

The manual has been well produced, the type being clear, and the illustrations numerous and good

R M D

Modern Light

Müller-Pouillets Lehrbuch der Physik Elfte Auflage Herausgegeben von A Eucken, O Lummer und E Waetzmann In funf Banden Band 2 *Lehre von der strahlenden Energie (Optik)* Herausgegeben von Karl Wilhelm Meissner Zweite Halfte, Erster Teil Pp xvi + 929 1708 + 19 Zweite Halfte, Zweiter Teil Pp xv + 1709 2392 (Braunschweig Friedr Vieweg und Sohn A -G , 1929) 87 50 gold marks

THESE important contributions to the literature on optics have been produced under very adverse conditions The initial responsibility for their production was assumed by O Lummer, who arranged the division of the work and its distribution among various contributors Unfortunately, Lummer died in July 1925, when the work was in an advanced stage and the first half volume of "Die Lehre von der strahlenden Energie" was already in the press The first half volume, therefore, appeared in 1926, and the two books which form the second half-volume are now before us The long interval of time between the appearance of the first and second half volumes is due partly to the withdrawal of many of Lummer's associates from active participation in the work, and partly to the need for considerable revision and enlargement of the articles which were ready for the press at the time of Lummer's death, in order to bring them up to date

In spite of these serious difficulties, the new editor, K W Meissner, has produced two books which will be regarded by all teachers of physics as extremely valuable contributions, although it must be recorded that their contents are overwhelmingly drawn from German sources As Lummer's original plan of production had more or less to be maintained, there is some slight overlapping, but only one or two important points have been omitted from the work The books are profusely illustrated, and many of the illustrations have great pedagogical value

Meissner commences the new half volume with a short section on plane polarised light, which is followed by sections on double refraction, rotation of the plane of polarisation, and the crystal optics of X rays, by E Buchwald The mathematical treatment of the Fresnel wave theory is rather condensed, but we appreciate the clear explanation of the way in which a modern polarimeter should be used On photometry the English reader has excellent sources of information in his own tongue, but the article contributed by H Kohn is not without distinction His discussion of Lambert's law is particularly good, as also are his descriptions of modern spectro photometers and colorimeters, we wish, however, that he did not consider it necessary to express the pentane lamp as 10/9 Hefner unit The apparatus and technique for the investigation of the whole spectrum are described in a series of articles by Czerny, Gehrcke, Hettner, and Meissner The methods described for producing spectra include the explosion of wires and King's carbon furnace Czerny and Hettner are also responsible for an excellent article on black body radiation, although the experimental portions do not take into account work carried out later than 1926, and no modern American experiments are described The theoretical portions have, however, been brought up to date by W Pauli, who, incidentally, emphasises that the Compton effect provides a proof that the pressure of radiation is discontinuous R Minkowski completes the first book with a long chapter on the theory of reflection, refraction, and dispersion, in which adequate attention is paid to modern developments

The second book opens with an introductory chapter on the fundamental ideas of the quantum theory applied to atomic structure Although this introduction is very good, it would not excite enthusiasm were it not for the fact that to it are added sections on the magnetic properties of electrons and on the new wave mechanics These additions increase the value of the chapter enormously, although it is felt that more attention could well have been paid to the experimental aspects, and, for example, some mention made of G P Thomson's work The reader will have little difficulty in following the excellent summary of Heisenberg's theory of the helium spectrum, which led directly to the prediction of the two forms of hydrogen

A short description of the production of spectral lines by G Hertz is the prelude to lengthy contributions by F Paschen and A Kratzer, who respectively describe in detail the structure and origin of line and band spectra The investigation and theory of the Zeeman effect are very ably summarised by E Back, whose work with intense magnetic fields is so well known D Coster is responsible for the treatment of X-ray spectroscopy He gives a historical outline of its development, and then describes in detail the design of modern X ray tubes and spectrographs for research purposes He discusses the bearing of Bohr and Stoner's ideas on the experimental results and devotes considerable attention to the continuous X-ray spectrum and to the phenomena of dispersion

Of all the German workers on radioactivity, few can be better qualified to write on X-rays than Fräulein Lise Meitner Her contribution is brief and to the point, but would be improved by the provision of more diagrams The contributions of R Ladenburg on magneto- and electro-optics are very impressive R W Pohl deals with photoelectricity, but his treatment of the main phenomena is rather of the nature of a summary This is mainly because he confines himself to the purely optical aspects of photoelectricity We would certainly have expected some reference to the work of Auger in the section on the photoelectric effect in gases, for there exists at least one excellent summary of this work in German B Gudden is responsible for the articles on fluorescence and phosphorescence They cover a wide field, but the average English reader will be surprised at the smallness of the space devoted to the effect of collisions of the second kind on the fluorescence of gases He will also be surprised at the frequent omission of names from the index to the half volume, but this will only slightly diminish his respect for an excellent work

International Astronomical Union

International Research Council International Astronomical Union (Union Astronomique Internationale) Transactions of the International Astronomical Union Vol 3 *Third General Assembly held at Leiden, July 5 to July 13, 1928* Edited by F J M Stratton Pp ix + 348 (Cambridge At the University Press, 1929) 15*s* net

THE third volume of the *Transactions* of the International Astronomical Union, embodying an account of the proceedings at the third general assembly held at Leyden in July 1929, is a valuable document which, in its general form, closely resembles the previous volumes It opens with the reports of the executive committee and the various commissions of which the Union consists, which were circulated to members before the meeting and formed the basis of discussion The modifications and decisions which were made at Leyden have, however, been included so far as possible without incurring heavy expenditure on printing, so that this part of the *Transactions* differs to some extent from the reports issued before the meeting

The volume under notice forms, in fact, a fairly complete statement of the present position of the programmes of research in the various departments of astronomy For actual completeness, however, Part 3 also must be consulted, which gives an account of the meetings of each commission at Leyden, with the recommendations adopted Part 2 deals with the inaugural ceremony and opening general assembly, and Part 4 with the closing general assembly Most of the material in the first four sections is given in English In Part 5 the several resolutions adopted by the Union are collected in a classified form and given in French A number of appendices record the statutes of the International Research Council and the International Astronomical Union, the names of members of the committees and commissions, and other cognate information

It is much to be hoped that the efforts of the Union to standardise the procedure of astronomers in certain matters hitherto left to individual choice will meet with the success they deserve Such matters as the definition of the galactic system of co ordinates, the form adopted in publishing astronomical papers, and the abbreviations by which recognised publications, societies, etc , are represented, have been given serious and praiseworthy attention by the respective commissions, and their recommendations, if generally adopted, would greatly facilitate the work of astronomers In particular we would mention the recommendation, already adopted by some editors, that every astronomical paper should be accompanied by a short summary The Union has, of course, no power to enforce its desires on these points, and this is an additional reason why attention should be specially directed to them

To those who were fortunate enough to attend the Leyden meeting, this volume will come as a welcome reminder of a delightful experience, and to astronomers everywhere it will be an indispensable guide Prof Stratton is to be congratulated on well maintaining the high standard set by previous volumes

Our Bookshelf.

Practical Design of Simple Steel Structures By David S Stewart (The Glasgow Text-Books, edited by G Moncur) Vol 1 *Shop Practice, Riveted Connections and Beams, etc* Pp xv + 183 12*s* Vol 2 *Plate Girders, Columns, Trusses, etc* Pp xv + 215 16*s* (London . Constable and Co , Ltd , 1929)

TEXT-BOOKS on structural engineering are now so numerous that justification for a new one must really be difficult to find The field is certainly amply covered by many excellent treatises, the names of which will at once suggest themselves to the student and the practitioner In the majority

of these publications, however, theoretical considerations are paramount, sometimes to the exclusion of all others Guided by their instruction, the student would be fully equipped to design structures on correct scientific principles But, in actual practice, there are divergences from theoretical considerations on various grounds, and this aspect of the subject is generally but slightly touched upon In the case of the present volumes, such a defect does not exist, and they are to be welcomed as a most valuable vade mecum to the inexperienced and the beginner They are full of practical hints and directions of sound economical value, such as (to mention only a few) the limitations in the rolling of steel plates and sections, and the extras chargeable on excess sizes, the deterrent effect of meticulous drawings and specifications on the obtainment of reasonable quotations, the loss due to scrap material, etc Some of the hints appear to affect minor details, but the cumulative effect is considerable Perusal of the work, with its clear appreciation of the practical aspect of structural design, was a distinct pleasure

In a short notice it is only possible to deal very briefly with the contents of the volumes, but a summarised statement is as follows Vol 1 consists of eleven chapters dealing with rolled sections for structural purposes , drawing office , template loft and the works , fastenings, pitches, and simple riveted joints of plates , flange plate splices , splices for angles, joists, and channels , splices for the web plates of plate girders , eccentric riveted connexions , wind pressure—factors of safety , beams and the design of a joist and channel crane gantry girder Vol 2 has nine chapters dealing with plate girders , design of a 40-ft span gantry girder , axially loaded columns and their foundations , non axially loaded columns , design of a 55 ft span roof truss , roof trusses , portal trusses and workshops , design of a lattice girder footbridge , and design of a 70-ft span through railway bridge Full details of the designs are given and many examples are worked out in detail, both in symbols and numerically Altogether, excellent volumes and cordially to be recommended

B C

An Introduction to the Study of Map Projections By J A Steers Second and revised edition Pp xxiii + 204 (London University of London Press, Ltd , 1929) 8*s* 6*d* net

THIS little book is, in the main, what it professes to be, and is written chiefly for those students of geography who have but little knowledge of mathematics For that reason the study is cast largely in an elementary geometrical form, and mathematical symbols are, where possible, avoided The plan of the book includes chapters on the properties of projections, their systems, the measurement of areas, the use of scales, and then a description and explanation of the more common projections, especially those to be found in atlases, and those of practical use in topography Given the limitations imposed on himself by the author, the book fulfils its purpose, and its appeal to the non mathematical student is evidenced by the fact that this second edition has been called for three years after the issue of the first

A few matters might perhaps be considered by the author before the preparation of a third edition The use of the word ' normal ' instead of the usual term ' polar ', for that particular case of zenithal projections, seems to be an unnecessary alteration in established practice The statement on p 170 that the 6 inch maps of the Ordnance Survey are plotted by rectangular co ordinates from a central meridian, might give the impression that there is one such meridian, whereas these maps are plotted by counties or groups of counties At the beginning of the book appears a classification in which all projections which are not zenithal, conical, or cylindrical are boldly dumped together as conventional—a possible arrangement, but not commonly accepted Finally, it may be as well to sound a note of warning against the habit of looking at map projections from a purely geometrical point of view No thoroughly sound understanding of the beautiful subject of map projections can be arrived at through geometrical constructions

A History of the Birds of Essex By William E Glegg Pp xxxv + 342 + 20 plates (London H F and G Witherby, 1929) 25*s* net

THIRTY-NINE years ago Mr Miller Christy's well-known work on ' The Birds of Essex " was published, and advances in the technique of identification as well as some changes in the status of the birds themselves have taken place during the intervening years This new volume, which takes account of the changes and deals critically with the older as well as with new records, must therefore supplant in most respects the earlier work as the text book of Essex ornithologists The avifauna of the county is now known to comprise 281 forms, of which 95 are breeding birds, 26 are regular winter visitors (although it will be noted that in each of these figures there is a discrepancy between the statements on pp xxiv and xxxiv), and 160 are birds of passage or irregular visitors

In connexion with each species are given the records of local occurrences and distribution, migration movements and their dates The book contains just the information that the local naturalist demands, and the introduction, which with advantage might have been very considerably extended, places parochial details in a more general setting

Chemistry of Pulp and Paper Making By Edwin Sutermeister Second edition, rewritten Pp x + 565 (New York John Wiley and Sons, Inc , London Chapman and Hall, Ltd , 1929) 32*s* 6*d* net

THE new edition of this valuable work, which first appeared in 1920, has been carefully revised and brought up to-date In incorporating the fresh material, the author has continued his useful practice of giving the original sources of his information in footnotes The work is admirably printed and illustrated, and it will be welcomed by an increasing number of chemical workers in the pulp and paper industry

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

The 'Wave-band' Theory of Wireless Transmission

THE article on this subject in NATURE of Jan 18 by Sir Ambrose Fleming is scarcely a complete statement of the usually accepted 'wave band' theory, and unless the more complete aspects of this theory and their significance with respect to the number of wireless telephone stations that can operate on a given range of wave length, and with regard to the possibilities of the extensive use of television, are correctly stated, it is to be feared that misconceptions will arise

The so called 'side bands' are more than a mere mathematical conception Their existence admits of the simple experimental demonstration of taking a resonance curve of a selective receiver with an unmodulated, and then with a modulated, valve oscillator In the latter case resonant 'humps' can be shown to exist at the frequencies $(p \pm q)/2\pi$, $(p \pm 2q)/2\pi$, etc The same experiment shows that a selective receiver responds to a modulated electromotive force quite differently from an unselective receiver, and it is here perhaps that the real explanation is to be found of the width of frequency band found necessary in practice If a sudden change of amplitude takes place an undamped receiver will continue to oscillate for many cycles before its amplitude falls correspondingly Its response to sudden changes is therefore not strictly in accordance with the changes of the received impulse and the rendering is imperfect The well known effect of excessive reaction in a broadcast receiver is due to this cause A heavily damped oscillator, however, follows quickly the changes of amplitude and gives a true rendering But such a heavily damped oscillator cannot be limited to picking up energy from a narrow band of frequency Or, as the wave band theorists express it, the sudden changes involve a certain 'width of band'

Thus, whether the side bands exist or not is merely a matter of a choice of points of view The final results are the same, namely, that a considerable range of frequency is necessary for each line of communication, and the higher the frequency of the changes, the wider the range of frequency on which energy must be received by the receiver Hence, since television involves the greatest rapidity of change of amplitude, it also necessarily involves the most highly damped receiver and thus the widest band of frequency

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IN NATURE of Jan 18, Sir Ambrose Fleming presents the wave band theory of wireless transmission as a mathematical fiction and issues a caution against being misled by the assumption of any physical reality in the so called 'side waves' It can be shown, however, not only that this assumption is perfectly justifiable, but also that the other mode of thought is liable to lead to false conclusions

Adopting Sir Ambrose Fleming's notation, we may write for the modulated part of a high frequency signal

$$a = A \cos qt \sin pt,$$

in which $q/2\pi$ is the audio frequency and $p/2\pi$ is the radio frequency This is mathematically indistinguishable from

$$\tfrac{1}{2}A(\sin \overline{p+q}t + \sin \overline{p-q}t),$$

and the question arises whether there is *any* sort of distinction The same kind of question arises when we attempt to distinguish a force from the vector sum of its components, and either question is one of philosophy which need not concern us here

The inference which one is invited to draw from Sir Ambrose Fleming's article is that if a signal $\Sigma A \cos qt \sin pt$ were applied to a band pass filter with a pass range of $p - q_0$ to $p + q_0$ it would emerge intact, but everybody knows that in fact all the terms corresponding to $q>q_0$ are cut down

The possibility of filtering out side waves, and of 'single side band' transmission and the like, are the usual arguments for their physical existence, but the root of the matter and the relation between the two points of view can be more clearly exhibited thus

The solution of any electrical network problem turns on the solution of simultaneous or possibly partial linear differential equations which may be typefied by a simple case

$$\ddot{y} + B\dot{y} + Cy = f(t)$$

Here y is the current in a certain branch and $f(t)$ is the 'driving force', which may, for example, be $A \cos qt \sin pt$ In this form there is no generally known method of solution, but if the right hand side is replaced by $\tfrac{1}{2}A$ ($\sin \overline{p-q}t + \sin \overline{p+q}t$), the equation assumes a well known standard form and the solution is equally a solution of the original, because there is no mathematical distinction between the two forms of the right hand side

Occasionally it is possible to recombine the $\overline{p-q}t$ and $\overline{p+q}t$ terms occurring in the solution, in this event one might regard the introduction of the side wave terms as a mathematical fiction, but far more generally no such recombination is possible, and this is the basis of the 'real side wave' viewpoint

Even so it may be possible to develop a calculus of the subject which does not employ the side wave concept, but it is difficult to see how it could fail to be cumbersome, and certainly less convenient than the known methods But if it is proposed to think on such lines, an amendment does seem necessary to Sir Ambrose Fleming's statement, "The whole question at issue then is, What range of amplitude is admissible?" The question surely is not how *much* the amplitude may vary, but at what frequency

LESLIE H BEDFORD

IT is evident there are strong differences of opinion as to the validity of the accepted 'wave band' theory Prof Fortescue and Mr Bedford have stated with great clearness their views May I present the following considerations on the opposite side?

If a highly selective wireless receiver associated with a good moving coil loud speaker is used to receive vocal or instrumental music from a broadcast station, we do not find that we have any imperfect reproduction of high notes relatively to bass notes in receiving music broadcast If we are in tune for very low frequency acoustic modulation or bass notes, we are also in tune for high frequency or shrill notes If this was not the case, we should have to keep on adjusting our receiver as the pitch of the music varied

Now musical pitch varies from 40 to 4000, and if the carrier wave has a frequency, say, of 193 kc/s (long wave Daventry), then the ordinary theory would assert that for each of the highest notes of the orchestra there are two simultaneous carrier waves emitted which may differ in frequency by as much as 4 per cent

A good selective receiver cannot respond equally well to waves differing so much in frequency If, then, these two component waves really exist, we should have to set our receiver condenser so as to pick them up in equal strength, without which the modulation would not be created If the receiver resonance curve is sharp, this implies that on the band theory high notes in music would not be reproduced sufficiently loud relatively to low notes Hence one would be led to the conclusion that the best results would be obtained by the use of a not very selective receiver But that is contrary to experience Makers of wireless receivers endeavour to give them the highest selectivity - not only to get the best results on one broadcast station but also to exclude that back ground of noise which is due to the jam of waves in the ether at present of closely adjacent frequencies

What we require to improve broadcasting is greater constancy in emitted carrier wave length and greater selectivity in all receivers

If it were merely a question of formulating explana tions, everyone is entitled to regard the results in whatever light he pleases or to employ what mathe matical artifices enables him to solve equations But when we come to practice and official regulations, it is a great disadvantage from the point of view of experimental progress to have these official regulations such as the 9 kilocycle wide wave band, based upon a merely theoretical interpretation of certain facts, and moreover an interpretation which seems out of agreement with practical experience

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Light in Four Dimensional Space

IN works on relativity little mention is made of the plane in which light travels in four dimensional space If we assume that a small body sends out rays of light in a three dimensional plane at right angles to its world line, the form of the equation for the interval ds

$$ds^2 = c^2dt^2 - dx^2 - dy^2 - dz^2 \qquad (1)$$

can be simply explained without the use of imaginary angles and imaginary time

Let the plane of Fig 1 be a section of four dimen sional Euclidean space containing the world lines of the following particles or observers AA, BB, and CC at rest relative to each other, and DD in motion relative to the other three The sinuous lines re present the bobs of the pendulums of two clocks travelling with A and D *Time* in the case of each observer has of course the direction of his own world line At P and Q rays of light are sent out from DD They travel at right angles to DD in three dimensional planes, which cut the plane of the diagram in the lines XX and YY An observer AA wishing to measure the interval PQ will make the two measurements, dx with a foot rule and dt with his clock. He will then calculate the interval by the formula

$$ds^2 = \tfrac{1}{2}c^2dt^2\left\{1 + \sqrt{1 - 4\left(\frac{dx}{cdt}\right)^2}\right\} \qquad (2)$$

which follows immediately from the geometry of the figure, for $dx/\sin\theta = ds = cdt\cos\theta$

where $ds^2 = c^2dt^2\cos^2\theta = \tfrac{1}{2}c^2dt^2\{1+\cos 2\theta\}$

$$= \tfrac{1}{2}c^2dt^2\left\{1 + \sqrt{1 - 4\left(\frac{dx}{cdt}\right)^2}\right\}$$

In this form ds is invariant to all observers If we write $v = dx/cdt$ and neglect high powers of v, formula (2) becomes

$$ds^2 = c^2dt^2(1 - v^4 - \qquad) - dx^2 \qquad (3)$$

which reduces to formula (1) when the relative velocity is neglected altogether

Observer AA is very much handicapped in his choice of co ordinates A fictitious observer at right angles to him, or to the plane of the diagram, for example, could measure the co ordinate dp with a foot rule, which would give the simple formula

$$ds^2 = dx^2 + dp^2 \qquad (4)$$

In practice, however, he must be content with the indirect measurement dt and must not expect even the simplicity of formula (1) We have assumed *flat* four dimensional space In curved space, XX and YY will become geodesics AA must know the value of the Riemann Christoffel tensor at every point along the path of the light and correct formula (2) accordingly

In the case of two observers whose world-lines

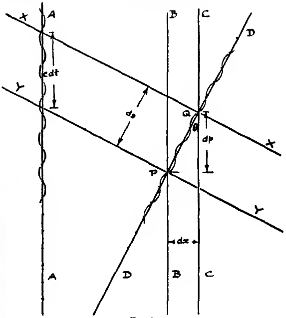

FIG 1

lie in the plane of the diagram and are inclined at an angle α, the transformation formulæ become

$$dt' = \frac{dt}{\cos\alpha}\{1 + \tan\alpha\tan\theta\}^{-1} \qquad (5)$$

$$dx' = dx\cos\alpha\{1 - \tan\alpha\cot\theta\} \qquad (6)$$

where $\theta = \tfrac{1}{2}\sin^{-1}\left(2\frac{dx}{cdt}\right)$

Formulæ (5) and (6) are derived from the relations

$$cdt'\cos\theta' = ds = cdt\cos\theta,$$
$$dx'/\sin\theta' = ds = dx/\sin\theta,$$
$$\theta' = \theta - \alpha$$

If we neglect powers of $\tan\alpha$ and of v, $=dx/cdt$, and write $u = c\tan\alpha$ the formulæ reduce to

$$cdt' = \frac{1}{\cos\alpha}\{cdt - dx\frac{u}{c}(1 + v^2 - \qquad)\} \qquad (7)$$

$$dx' = \cos\alpha\{dx - dtu(1 - v^2 - \qquad)\} \qquad (8)$$

If v^2 is neglected and β put in place of $\sec\alpha$, they correspond very closely to those of the Lorentz transformation as given in Eddington's "Mathe matical Theory of Relativity"

The question naturally arises Is the velocity of light a measure of the curvature of space and would it be infinite in flat space ? Assume that the measure

ment is made between two mirrors A and B at a fixed distance apart In a gravitational field the world lines of A and B will not be parallel Light leaves A at right angles and travels in a geodesic to B It returns starting at right angles to B and the return geodesic cuts A at A', which in general will not coincide with the starting point The difference in time which is due to the curvature of space will be taken as a measure (inverse) of the velocity of light Cannot the velocity of light be expressed in terms of the Riemann Christoffel tensor ? In formulæ (1) c is usually identified with the velocity of light, but AA will have to adjust the value of it if his acceleration of gravity changes and the latter is a function of the curvature of space

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Intracellular Bodies in Plant Virus Diseases

IT has been known since 1903, when Iwanowski's paper on tobacco mosaic appeared, that virus disease in plants is frequently accompanied by the appearance within the cells of abnormal inclusions bearing some resemblance to amœbæ These inclusions, or 'X bodies', are well defined masses of granular or finely reticulate material not unlike protoplasm, typically rounded or roughly spherical in shape, though often elongated, and usually containing in their substance vacuoles, which vary in number from one to as many as ten or eleven The resemblance to amœbæ is heightened by the not infrequent appearance of lateral projections suggesting pseudopodia, and the occurrence of bodies constricted in such a fashion as to suggest fission has led several observers to believe that these X bodies are in fact living organisms or plasmodial colonies of organisms, which represent some stage in the life history of the virus parasite

Some fresh light has been thrown on the formation and nature of these bodies by a study of them as they occur in *Solanum nodiflorum*, when infected with the yellow or aucuba mosaic of tomato In this plant the hairs stand out stiffly from the leaves and lend themselves to examination in the living state, under quite high magnification, without further treatment than mounting the leaf in water or other suitable medium The bodies in the cells of infected hairs are unusually conspicuous, and ordinarily occur uncomplicated by the other abnormal structures, for example, striate material, crystal plates, etc, which are usual in the cells of mosaic tobacco, tomato or other plants, although a long crystalline spike is frequently seen lengthways in the cell They can be readily seen in cells of other type than the hair cells, for example, in epidermal or palisade cells of the leaf, but in these situations some operative interference is necessary to show them clearly

It was noticed by one of us (F M L S) that in the early stages of infection there appear in the streaming cytoplasm of the hair cells small particles, which are carried along in the stream and tend to aggregate together to the formation of larger masses, and it has been found possible to follow in the individual living cell the formation of the X-body from its early beginnings to its completion A young plant is inoculated and, when the first signs of the disease appear, a suitable leaf is detached, and under the microscope the hairs projecting from its margin examined seriatim The leaf is then placed with its petiole in water or nutrient solution, and examined again from time to time at short intervals, the appearance and development of the X bodies can be watched in selected individual hairs for many days

At the first examination, no bodies may be visible in any hairs In a few hours tiny particles appear in the cytoplasmic strands and are carried round the cell in the stream As time goes on, these particles increase in size, and at the anastomoses of the strands tend to hesitate or halt for a longer or shorter time before they move on, their further progress being facilitated by modification of the strands and by alteration in shape of the plastic particles themselves With still further increase of size, the halts become longer they may last for a couple of hours or more At such a halt another particle may join the stationary one, and when the movement is resumed the two may again separate or they may go on together as one mass By successive increments large masses are eventually formed which are readily recognisable as X bodies There may be several such masses in a single cell, which continue to move independently of one another, or they may coalesce to form one or more larger masses

These composite masses may remain permanently in union, and, when they do, they seem to fuse together, as it were, into a more homogeneous whole, in which vacuolation can be observed, even in quite small masses vacuolation is sometimes observable Sometimes, however, a composite mass may again separate, even after long contact, into its constituent parts which resume their independent movement When this occurs, figures are seen which look quite like a process of fission, but it is not a case of division in the sense of multiplication, since the separate portions may again unite Similarly, when a smaller mass breaks away from, or joins up with, a larger mass appearances may be presented which simulate pseudopodia, and have been so interpreted In leaves which have been infected for several weeks, breaking down of the bodies is comparatively common

This mode of formation accounts for many of the appearances which have led to the belief that X bodies are living creatures, for example, the pseudopodia, the fission figures, the occurrence of several bodies in one cell (which has been attributed to division of a parent body) It also explains the great tendency of X bodies to be associated in position with the nucleus, since it is round the nucleus that the protoplasmic strands cross and anastomose most freely, and it is in such situations that aggregation tends to occur Of the nature of the small particles themselves it is too early to say anything definite They give the impression of being foci where the protoplasm has condensed or solidified, and are of no fixed shape There is no sign of autonomous movement and nothing to suggest that either they or the complete body is living, in the sense of being an independent organism or parasite

The possibility that they are cytoplasmic condensations is strengthened by the fact that X bodies are protein in nature They give the usual protein reactions, such as Millon, Raspail, biuret, and various aldehyde tests, they are soluble in acid and alkali of sufficient strength, insoluble on boiling and in alcohol They have a distinct tendency to crystallise out, especially in old leaves, and the crystals have all the characters of protein crystals, such as are seen in aleurone grains, including the tendency to take semi-crystalline forms with faces and angles on only part of their surface In polarised light these crystals do not appear, nor does the uncrystallised body, though sometimes one or two small doubly refracting crystals may be seen lying on the surface of the body or embedded in its substance

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Insect Pests of Willows

ALL plants of the genus *Salix* are attractive hosts for destructive insects In the case of basket willows, attacks of varying degrees of intensity are of annual occurrence A loss of 50 per cent is frequently experienced amongst willow growers, while at times insect invasion is so great as to render the crop totally worthless for basket making purposes

There is scope for extension of the willow growing industry in Great Britain for the following reasons

(1) The climate suits the willow crop, no other country being able to produce rods superior in quality to the best English grown varieties

(2) A considerable area of suitable land, now producing crops of little or no value, could be brought under profitable willow cultivation

(3) The demand of the basket making industry of the country for its raw material is not fully met from English sources, the annual value of basket making material and of basket ware imported being £170,000 and £400,000 respectively

(4) No willow rods are exported

In spite of the heavy losses due to insect attacks, the willow crop under average conditions is profitable, but it is probable if destructive insects could be kept reasonably in check the financial returns from the crop would be such as to make willow growing the most profitable amongst agricultural crops, and should extend and improve our basket making industry and ultimately result in English grown willow rods becoming an article of export

We are primarily concerned in this communication with an investigation on the life-history, behaviour, and methods of control of the principal willow pests To mention one or two, such as *Phyllodecta* species and *Galerucella luteola*, these produce damage in two ways the first and more serious by the attack on the growing terminal buds and resulting development of side shoots which ruins the rods, and secondly the impaired vitality of the plant through the loss of foliage by the adult and larval attack, and consequently causing considerable reduction in yields and quality

Galerucella luteola appears to be confined to *Salix triandra* varieties, and as this species of willow is grown extensively this beetle pest is frequently seen

Phyllodecta vitellinæ will attack many species of willow, particularly *Salix purpurea* and varieties, and *Salix alba vitellina*, whilst *Salix triandra* is never attacked

Phyllodecta vulgatissima appears to be confined to *Salix viminalis* varieties

The above three species of Chrysomelid beetles are major pests, and it is seen that the principal species of willows grown for basket work are attacked

Another pest, the bean gall sawfly of willows (galls are produced on the leaves by the oviposition of the sawfly *Pontania gallicola* Steph and occur commonly in huge numbers on *Salix triandra*, *S fragilis*, and *S alba*), is not considered by growers a serious pest, although cases occur when the crop of rods is weighed down to the ground by the mass of galls The damage is not always so obvious, but the gall formation when many leaves are attacked may cause a drain on the plant and probably results in reduced yields in the year of attack, and the vitality of the plant is impaired the following season

Briefly, the life history of this pest is as follows

The sawfly hibernates as a full grown larva in a waterproof cocoon under loose bark, etc, during the winter In spring the larva pupates and the adult emerges in early May, and oviposits in the terminal, unfolding leaves of the willow The gall very quickly develops and forms food for the larva inside, and the larva is full grown about the third week in June The larva cuts an exit hole in the gall and in due course pupates in cracks in the bark of willow stumps near the ground A second brood of adults appear at the end of July Still, sunny weather greatly facilitates oviposition and a large number of galls results It is this second crop of galls that cause the damage to the plant In mid September the majority of the larvæ are full grown and these go to their hibernation quarters

The second brood of sawfly larvæ is frequently attacked by Hymenopterous parasites, and in some seasons nearly every larva is found parasitised However, this natural control does not help the existing crop, as the damage has been done by the sawflies at the moment of oviposition, but possibly checks injury to the crop by reducing the intensity of the attack the following season

The bionomics of the above insect and other willow pests such as *Phyllodecta* sps, *Galerucella luteola*, the willow sawflies, and willow aphids are under investigation at the Research Station, Long Ashton

In the past the willow pests have not been studied in detail, and it is hoped that eventually a better knowledge of them will result in the returns for the willow growers being considerably increased

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H G H KEARNS

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Jan 11

Raman Effect in the X-Ray Region

ATTEMPTS have been made to trace the Raman effect in the X ray region, the study of this phenomenon would be in this case very interesting because it would be a purely electronic effect due to variations in the stationary positions of the electrons Experimental results, however, are not consistent, Bergen and Davis (*Phys Rev*, **33**, 338, 1929) succeeded in obtaining, besides Compton radiation and the line of the same frequency, other radiations which can be well interpreted as Raman radiation These workers experimented with carbon and beryllium as the diffusing substances and used an ionisation camera, other workers using photographic methods did not obtain any Raman effect (Ehrenberg, *Zeit fur Phys*, **53**, 234, 1929) Similarly, Kast (*Zeit fur Phys*, **58**, 519, 1929), using aluminium as diffusing substance, found nothing but the classical and Compton radiation

It should be noted that the Raman electronic effect will appear in the X ray region under the following conditions the electron in one of the Röntgen levels K, L, M must be able to pass from one of these levels to an X level which is not yet filled up, or to an optical orbit at the periphery of the atom In both cases the substance showing the effect must show the so called semi optical lines, that is, absorption lines in the X ray region Such lines show themselves as a fine structure at the limits of the continuous absorption bands It should be noted, however, that not all the elements showing such fine structure can present this effect, because, as modern researches have proved, such fine structure is frequently due to a process of double ionisation On the contrary, a substance suitable for the study of this effect would be argon, because, as Coster (NATURE, **117**, 586, 1926) has shown, in this element the passage of an electron from an orbit K to an orbit $2p$ has been controlled

We have examined the question theoretically and calculated the intensity to be expected, and we give here the essential results The problem has been treated like the problem of the Compton effect, which has been already explained with great success by Wentzel (*Phys Zeit*, **43**, 1 779 and,

1927) and Sommerfeld ("Atombau Wellenn Erg", p 251) Supposing that an electron could pass from an orbit K, L . to an optical orbit, we approached the problem using Schrödinger's functions ψ relative to the H, assuming that the exciting frequency is much larger than the frequency of the limits of absorption In these conditions, we have obtained by calculations that the intensity of the Raman lines is different according as the initial state is K or L or M level and the final state is the optical level $1s$, and is also different if the final state instead of $1s$ becomes the state $2p$ We have found that, indicating by E_e the kinetic energy of the electron emitted for the Compton effect in one particular direction of observation, and with one particular exciting frequency, the intensity of the Raman line for an element of atomic number Z observed along the same direction is proportional to the quantity

$$Z^{-2}\left(1+\frac{E_e}{|E_\mu|}\right)^{-4}$$

where $|E_\mu|$ is the energy of the K level if the jump is $K \longrightarrow 1s$ As the intensity of the undisplaced line is proportional to

$$\left(1+\frac{E_e}{4|E_\mu|}\right)^{-4}$$

we see that the relation of the intensity of the Raman line to the undisplaced line is practically inversely proportional to the cube of the atomic number More complex expressions have been obtained for the jumps $L \dashrightarrow 1s$, $M \dashrightarrow 1s$ If the final optical orbit is a level $2p$, then the intensity is proportional to Z^{-6}

From our theoretical investigations we conclude that to observe this effect it is necessary (1) to use substances presenting semi optical lines, (2) to use substances of low atomic number, (3) to use exciting wave lengths, directions of observations, and substances for which the relation $\frac{E_e}{|E_\mu|}$ is very high

Details of calculations will be published elsewhere

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20 Gennaio

Existence of two Limits of Predissociation in the Nitrogen Peroxide Molecule and the Heat of Dissociation of Oxygen

THE absorption spectrum of nitrogen peroxide vapour is composed of two regions the first from the red to about 2900 A , the second from 2596 A to about 2200 A These two regions correspond to two different electronic activations of the molecule

The first region is made up of a large number of bands and fine lines having a very complicated structure, which we are studying now with L Harris From the visible up to about 3700 A the bands are very fine with quite definite rotation lines , there are two or three fundamental vibration frequencies But between 3800 A and 3700 A the bands become broad and diffuse, the fine structure disappears This corresponds to the first limit of predissociation

In the second region we have obtained with L Harris between 2596 A and 2459 A a series of bands with a fine structure corresponding to a very clear double rotation spectrum , at $\lambda = 2459$ A, the bands become abruptly diffuse and broad and up to 2200 A there are nine such bands This is the second predissociation limit.

The physical interpretation of these two predissociation limits is that they correspond to the two limits of dissociation of the nitrogen peroxide molecule into nitric oxide and a *normal* or an *activated* oxygen atom

The corresponding energies are

(1) $NO_2 \longrightarrow NO + O$ − 77,000 cal (3700 A)
(2) $NO_2 \longrightarrow NO + O^*$ − 116,000 cal (2459 A)

The first is in exact agreement with the results obtained by Norrish (*Chem Soc* , June 1929), who obtained a photochemical dissociation of NO_2 into NO and O_2 by light of $\lambda = 3650$ A , and no action by $\lambda = 4300$ A , the light of $\lambda = 4050$ A giving a very slight reaction

From these results, the heat of dissociation of the oxygen molecule can be calculated

$$O_2 \longrightarrow O + O - 128{,}000 \text{ cal } (5\ 5 \text{ volts}),$$

and the activation of oxygen atoms

$$O \longrightarrow O^* - 39{,}000 \text{ cal } (1\ 7 \text{ volts} = 13{,}700 \text{ cm}^{-1})$$

The dissociation energy of the oxygen molecule was calculated first by Birge and Sponer as 163,000 cal (7 1 volts), then corrected by Birge (*Phys Rev* , **34**, 1062, Oct 1, 1929), Bristol meeting of Faraday Soc (Sept 24, 1929) to 5 6 − 6 5 volts, by Kassel (*Phys Rev* , **34**, 817 , 1929) to 5 0 − 5 5 volts, and by Mecke (*Naturwissenschaften*, Dec 20, 1929) to 5 6 volts

The active oxygen obtained from the second predissociation limit is probably in the metastable ^1D state

The value $^3P_2 - {}^1D$ is not known for oxygen , R Frerichs (*Phys Rev* , **34**, 1239 , Nov 1, 1929) gives a probable value of 15,500 cm $^{-1}$, McLennan (NATURE, Dec 7, 1929, p 874) has calculated by analogy with selenium and tellurium spectra a value of 10,587 cm $^{-1}$.

Our value is therefore the mean of the two

VICTOR HENRI

Institute of Physical Chemistry,
Zurich, Jan 17

Tides of the Upper Atmosphere and the Heights of Meteors

IN NATURE of Dec 14, 1929 (vol 124, p 913), the result of an examination of some data giving the heights at which the meteors disappear has been published There seemed to be a variation of these heights with the lunar hour angle By kind information from Dr G M B Dobson my attention was directed to a great number of observations of the heights of meteors given by Mr W F Denning in *Monthly Notices of the Roy Astron Soc* , March 1912 and January 1916 These observations (556) were divided into 6 groups and treated in the same manner as the former Using the same designations as in the former letter, the following values were found for the mean height at which the meteors disappear

Flood tide	46 9 ± 1 8 miles
+ 0	47 0 ± 1 1 ,,
− 0	49 2 ± 1 9 ,,
Ebb tide	49 1 ± 0 8 ,,

The mean error is derived from the 6 group means Examining in the same manner the heights at which the meteors appear, the following values for the mean height are found

Flood tide	70 1 ± 2 2 miles
+ 0	67 5 ± 1 9 ,,
− 0	70 8 ± 2 6 ,,
Ebb tide	71 6 ± 1·0 ,,

From the result of the former letter it would be expected that the mean height for flood tide (and + 0) should be greater than that for (− 0 and) ebb-tide, both for the heights referring to the disappearance of the meteors and for the heights referring to the appearance This is in no way the case; on the con-

trary, from the above tables it will be seen that the values for flood tide (and +0) are smaller From this it may be concluded that the result given in the former letter is due to an exceptional (but nevertheless an accidental) distribution of the heights examined A further examination has also shown that the numbers of heights under 55 km for flood tide, +0, −0, and ebb tide are 2, 3, 9, and 7, respectively The relatively great numbers for −0 and ebb tide have caused that an amplitude with a comparatively small mean error was found

After this it does not seem possible to obtain any trustworthy information as to the tides of the upper atmosphere from the meteor observations used hitherto, but it ought to be remarked that the highest meteors are not easily observed, and this circumstance might have influenced the result In this connexion, attention may be directed to the fact that, while the mean height for disappearance was 85 km in the former case, the mean height derived from the present data is 48 miles or 77 km, and, furthermore, that the number of observations for flood tide and ebb tide in the present case are 172 and 200, respectively

In NATURE of April 27, 1929 (vol 123, p 642), some results are given, which are based on an examination of the two maxima of the frequency curve of the heights of the bases of aurora This investigation led to the result that these maxima are due to the tides of the upper atmosphere It should be of great interest to learn whether new series of observations of the heights of the bases of the aurora confirm the existence of the peculiarity of the older series

J EGEDAL

Geofysisk Afdeling,
Meteorologisk Institut,
København, Jan 10

Natural Control of *Lucilia sericata*

AT the Farnham House Laboratory of the Imperial Bureau of Entomology, experiments are being carried on to determine the value of the braconid parasite *Alysia manducator* Panzer as a controlling agent of the sheep blowfly, *Lucilia sericata* Meigen Preliminary studies of the bionomics of the host have been in progress for nearly a year

The potential rate of reproduction of *Lucilia sericata* is very high Eight females the oviposition of which was followed completely laid an average of 1561 5 eggs, the most prolific of them depositing 1883 The eggs are almost completely viable, and large numbers can be reared to the adult stage with the loss of only 1 or 2 per cent In critical experiments this loss is kept below 1 per cent and in many cases can be quite eliminated Obviously such a high rate of reproduction is by no means attained in Nature Parasites play a part—at certain seasons of the year an important part—in the control, but the reduction seems to be principally brought about in another manner

In laboratory experiments it is found that if increasing numbers of eggs of the same age are placed on equal portions of meat under identical conditions, the increasing rigour of starvation has three effects (1) the size of the adults obtained becomes gradually smaller, (2) the mortality during the larval period gradually increases, (3) beyond a certain point fewer adults are obtained than the amount of food supplied is capable of supporting The last result may be attributed to the use of food by many first and second instar larvæ that are never able to complete their development, but deplete, by feeding, the amount of food available to those that are able to mature

During September and October 1929 this matter was studied under field conditions at Farnham Royal It was first ascertained that exposed meat is soon overblown In one case, 156 gm of meat exposed in bright sunshine bore 5645 eggs, principally of *Lucilia sericata*, after only five hours, although this amount of food could support no more than 1560 normal individuals Mice, rats, and guinea pigs were similarly provided in a few hours with far more eggs than could develop on their tissues Moreover, oviposition continued for at least ten days on animal remains from which thousands of half grown, starving larvæ were already migrating It was then determined that from pieces of beef and whole small mammals, exposed in both sunny and shady situations and known by observation to have been provided with immense numbers of eggs, comparatively few adults were obtained, fewer, in fact, than could have developed on the same food had a smaller number of eggs been laid

It appears, then, that the high reproductive rate of *Lucilia sericata* is largely offset by its habit of laying more eggs on a carcass than the latter can support This results, it is to be noticed, not only in the loss of the surplus eggs, but also in the death of individuals that would have survived had the additional eggs not been laid

GEORGE SALT

Farnham House Laboratory,
Imperial Bureau of Entomology,
Farnham Royal, Bucks

Crossed Connexion of the Cerebral Hemispheres with the Muscles and Sense Organs

THE crossed connexion of the mammalian cerebrum with muscles and sense organs is a condition derived from a more primitive state of the nervous system Thus, Ferrier found [1] that stimulation of the brain in frogs and fishes caused movements of the opposite side of the body That the crossing is a general phenomenon is shown by the crossing of nerve fibres in the nervous system and the decussation of the optic nerves in all vertebrates [2]

The crossed relationship is suggestive of an optical effect as the image (when real) of an object is always inverted, that is, on the opposite side of the optical axis In order that this optical inversion can be a factor in the development of the nervous system it is necessary to look for a primitive animal with a single median eye An example of such an animal is the larva of a simple ascidian in which an unpaired optic organ is present and the region where the images would be formed is represented by the enlarged anterior extremity of the nervous system [3]

The image of an object on the right of such an animal would be formed on the left side of the retina, and by a movement of the muscles on the right side of its tail it would move so that the image would be central By repeated correlation between stimulation due to an object and the movement to bring the image of it on the centre of the retina a relationship would be established in the same way that a conditioned reflex is developed

After such a relationship had been established, all those portions of the nervous system which grew out from that part of the nerve mass would show a crossed relationship This view is frankly Lamarckian, as it implies the inheritance of a relationship developed in response to a functional association

The cerebrum in man shows a further relation to optical projection as the upper margin of the calcarine fissure corresponds to the lower half of the visual field and the lower margin to the upper half, but the

[1] D Ferrier, "Functions of the Brain", 2nd edition, 1886, p 263
[2] J H Parsons, "Introduction to the Theory of Perception", chap vi. and p 121 (Cambridge University Press, 1927)
[3] W A Herdman, "Cambridge Natural History", Fishes, Ascidians, etc, p 60

architecture of the human cortex is too far removed from the primitive state to be used as an argument in support of the view that the contralateral connexions in vertebrates are the result of the formation of optical images in an unpaired median eye

The above suggestion may not be new, but it is not well known, and I have never heard of it There is no means by which it can be put to the test by experiment Ascidians are degenerate forms, but their larvæ may not be far removed from the primitive vertebrate stem

H E ROAF

London Hospital Medical College,
Jan 17

The Muscular Sense

I HAVE just seen Col Lynch's letter in NATURE of Jan 11, in which he criticises mine, which dealt with the muscular sense In order to experience a sensation, surely no "analysis of a searching character" is required, else the state of the child and of the savage would be peculiarly unfortunate In my letter in NATURE of Nov 23, I merely wished to describe a method involving no apparatus which permitted one to experience sensations produced by the activity of muscles engaged in raising or lowering the mass of the limbs I am aware that some psychologists have discussed the question whether these sensations in or of muscles are not rather sensations of the outgoing, cerebral, efferent impulses to the muscles I have always thought that view extremely unlikely and akin to learned trifling If it were true, would it not be very peculiar that we should not have any awareness of any other kinds of efferent innervations such as those of heart, blood vessels, or glands?

I did not set out to offer any "explanation" of the muscular sensation which involved or did not involve "a minute examination of a long series of neurological phenomena"

I still think the method I have described is an interesting one, because it is, to some extent, quantitative, in that the moment the limb rests on the water the sensation is minimal, and the moment it begins to be raised or lowered the sensation is increased in intensity I hope we may still be allowed to experience and report on sensations without being compelled to give "a valid analysis" of them "with the necessary rigour"

D F FRASER HARRIS

Chiswick, W 4, Jan 13

Sterilisation as a Practical Policy

MAY I add to the admirable review by Prof MacBride (NATURE, Jan 11, pp 40 42) that there is an urgent and immediate place for voluntary sterilisation in Great Britain side by side with voluntary birth control? The medical profession at present does not meet the demand of those conscious of heritable defect and with a sufficient sense of civil responsibility voluntarily to desire sterilisation Compulsory sterilisation of the unfit would require legalisation which we may properly hope may be passed before long, but to secure the voluntary sterilisation of those ready to ask for it requires such public propaganda as was given to constructive birth control But while it is easy to sterilise a male effectively and harmlessly, it is neither so easy nor so successful, as Prof MacBride's article would lead one to believe, to sterilise the female, the tying of the Fallopian tubes sometimes leading to internal pregnancies which are worse than the normal Nevertheless, as a social step it will be valuable to facilitate voluntary sterilisation even of the defective males who are conscious of their defect and willing to have vasectomy performed

The Society for Constructive Birth Control has for some time past been considering the possibilities for facilitating this and will be pleased to hear from competent surgeons willing to undertake such cases in any part of the country

MARIE C STOPES
(President)

Society for Constructive Birth Control
and Racial Progress,
108 Whitfield Street, London, W 1

Botanical Nomenclature

MAY I request the publication of a short note which I consider a point of importance in view of the forthcoming botanical conference in Britain?

Article 57 of the Vienna rules states "the original spelling of a name must be retained except in case of a typographic or orthographic error" The use of the word "spelling" along with the word "orthographic" in this sentence appears to many to override the original meaning of the latter word, namely, "correct writing", and to restrict it to the dictionary sense of correct spelling alone But correct writing is equally important with correct spelling To avoid ambiguity, I suggest Article 57 be amended to read "typographic, orthographic or syntactic error"

Is a man to be allowed to write sav, "ein schoner Buch" in German, or "une beau fille" in French, through ignorance or temperamental whimsy, without protest from lovers of good German or French? Why, then, should we allow our 'nodding *Homer*' of nomenclature, even, to palm off on us an orthographic blunder such as *Polygala sanguinea* instead of *P sanguineum*, or pass by uncorrected a recent new specific blunder like *Airosperma fusca* for *A fuscum*?

ROBERT A INGLIS

Central Experimental Farm,
Ottawa, Dec 16, 1929

Spectrum of Trebly Ionised Krypton

A SHORT note by me on the spectrum of doubly ionised krypton was published in NATURE of Feb 16, 1929 (vol 123, p 244) Since then the observational data with regard to the spectrum of krypton have been extended up to λ1930 A on the ultra violet side In the region of about 41,000 frequency units, some very strong lines, namely, 42,475 1(10) and 40,560 3(9), have been observed Although the lines of Kr^{++} due to the transition $3N_2(O_2 \leftarrow O_2)$ had been located near this region, it did not seem probable that this transition would give rise to such intense lines—lines more intense than the fundamental lines due to $3N_2(O_1 \leftarrow O_2)$

Further, by extrapolation by the method of horizontal comparison, it has been found that the fundamental lines of Kr^{+++} due to the transition $2N_2(O_1 \leftarrow O_2)$ would lie in this region

An attempt to find out these lines of Kr^{+++} has revealed a number of multiplets The lines 42,475 1(10) and 40,560 3(9) have been found to be the ${}^4P_3 - {}^4D_4$ and ${}^4P_2 - {}^4D_3$ lines

A complete analysis of this spectrum is in progress and will be published shortly

D P ACHARYA.

B N College, Patna,
Dec 3, 1929

The Raman Effect

By Dr A C MENZIES

INTRODUCTORY

IT is now just two years since the effect known by his name was discovered by Sir Chandrasakara Raman,[1] but the phenomenon has aroused so much interest that even in this short time a tremendous amount of work has been done A summary, therefore, at this stage may serve a useful purpose

In brief, the effect may be thus described When a beam of monochromatic light is directed into some transparent substance, some of the light is scattered, and this light has the same frequency as the incident light (unmodified scattering) In addition, a much smaller quantity of the light suffers a change of frequency, usually a diminution (modified scattering), and it is this which constitutes the Raman effect The magnitude of the change is found to depend upon the nature of the scattering material and is independent of the frequency of the incident light In general each exciting line evokes several modified lines, some of which may be plane polarised

On account of their superficial resemblance, it would be well to make clear the respects in which this effect differs from fluorescence

(a) In fluorescence, the frequencies of the fluorescent spectrum are independent of those of the exciting radiation, provided the latter are able to excite fluorescence at all On the other hand, the frequencies of the radiations modified by Raman scattering are directly related to the incident frequencies ν_i, being $(\nu_i \pm \nu_R)$ These shifts, ν_R, are either actual infra red frequencies in the absorption spectrum of the scattering material, or differences in such frequencies [2, 3] For example, measuring wave numbers in cm^{-1}, the frequencies 27354, 27290, 24704, and 22939 emitted by a mercury vapour lamp are scattered by benzene molecules and give rise to the Raman lines (among others) 24294, 24231, 21646, and 19877 respectively These, it will be seen, are lines shifted to the red by an amount 3060 cm^{-1} approximately, and correspond to an infra red wave length 3 27 μ, while the infra red absorption spectrum of benzene includes a a strong band at 3 25 μ

(b) The intensities of the Raman lines are of a different order of magnitude

(c) Many of the Raman lines are strongly polarised

TECHNIQUE

The first observations were made with complementary light filters, but this was abandoned in favour of spectroscopic methods The light from a mercury vapour lamp is directed by a large condensing lens into a flask and the light scattered at right angles is focused on to the slit of a spectrograph (flask method) This has been modified by R W Wood,[4] who uses a long tube, water cooled, placed parallel to a long tubular mercury arc and almost touching it Observation is made axially along the tube, and portions of the spectrum of the incident light may be filtered out by the addition of suitable colouring matter to the cooling water (tube method)

As a source for Raman scattering experiments, the mercury vapour lamp has the disadvantage that it cannot be arranged to give really monochromatic radiation For this reason, helium excitation is sometimes used,[5] since the strong line λ3888 A U can be isolated by ultra violet glass and the results are then unambiguous

Although most observations have been made in the visible region, the ultra violet region has been used as well, entailing the use of quartz throughout This region has the advantage that the Raman lines are considerably stronger It must be borne in mind, however, that chemical action may easily be induced by the use of such short wave exciting light, and the experiment thereby vitiated

When gases are to be investigated, the tube method is used, and the exposure may be shortened by having the gas under pressure

In the case of solids, a block is treated as in the flask method Recently, it has been shown by me [6] and independently by Bar [7] that the Raman spectra of solids in powder form may be obtained, since the incident radiation is much weakened by repeated reflections Thus the field for investigation is considerably greater, since only a few solids are obtainable in large pieces

WIDTH OF LINES

The scattered lines differ greatly in respect of width [8, 9] When scattered by crystals, the lines are particularly sharp, less sharp for amorphous solids, and some lines scattered from liquids are more diffuse still The change in sharpness in the transition from solid to liquid is well shown in the liquefaction of ice [10] In this case the lines become much broader when the ice melts, but with little alteration of frequency This, as pointed out by C P Snow (private communication), means that ice is a molecular lattice and not an ionic one In some liquids the lines are very sharp indeed, but quite frequently a continuous spectrum [11] is obtained, especially in very viscous liquids The unmodified lines are often diffusely broadened, this is perhaps to be accounted for as a Raman scattering where the incident radiation has been modified by the abstraction of energy required to produce changes in the rotational frequencies of the molecules [12]

INTENSITIES

If corresponding Raman lines (that is, lines having the same frequency shift from the different exciting lines) be considered, the intensity is augmented considerably as the frequency of the exciting line is increased It does not, however, follow the fourth power law [13] The Stokes lines (shifts to the red) are very much more intense than the corresponding anti-Stokes lines [14, 15] The ratio of the intensities of corresponding Stokes and

anti-Stokes lines has provided an interesting criterion for the quantum theory of dispersion Schrödinger's original dispersion theory implies an intensity-ratio equal to one[16] Statistical mechanics, however, yields intensity ratios in accordance with those observed[17 18]

EFFECT OF TEMPERATURE

Intimately connected with the consideration of the intensity-ratio just mentioned is the effect of change of temperature Whatever the true explanation of the Raman effect may be, jumps between quantised states must be involved and intensities will be affected by the molecular populations of these states So increase of temperature, which favours an increase in population in the higher states, is bound to augment the intensities of the anti-Stokes lines, and this is found to occur[19] In quartz, for example, a particular Stokes line has an intensity about two fifths of that of the corresponding unmodified line As the temperature is increased, the unmodified line increases in intensity, the anti Stokes line increases more rapidly and the Stokes line decreases slightly in intensity[20 21] At the same time, the lines become more diffuse, this has been attributed to an increase in the molecular rotation[22]

CRITICAL STATE

Ordinary unmodified scattering increases very considerably in intensity as the critical state is approached, but there is little corresponding increase in the intensity of the modified radiations This is taken as a proof that the modified radiations are incoherent[23, 24]

POLARISATION

In scattering by liquids, the modified lines may be plane polarised parallel to the direction of polarisation of the unmodified lines, partially polarised in this direction, or unpolarised[1 25] In scattering by solids, it is possible in addition for modified lines to be plane polarised in a direction perpendicular to that of the unmodified lines This has been shown to occur in quartz, and is related to the direction of the optic axis with regard to the directions of the incident and scattered beams A new orientation of the crystal produces a change in the direction of the plane of polarisation for some of the lines, but not for others[26 27]

SCATTERING IN GASES

It has been suggested that many of the weak lines listed in spectrum tables may be Raman lines excited by strong lines of the element involved For example, H S Allen suggests that some of the secondary lines of hydrogen may be Raman lines excited in the molecules by Balmer lines[28]

Hydrogen chloride gas gives a sharp Raman line corresponding to the 'missing' line in its absorption spectrum, together with some lines corresponding to molecular rotations[29] It is interesting that the changes in the rotational quantum number m for the Raman spectrum of HCl gas are given by

$$\Delta m = 0 \text{ or } \pm 2,$$

while in the infra-red absorption spectrum they are given by

$$\Delta m = \pm 1$$

This fits in with the 'three level' theory discussed later

Carbon monoxide gives a line corresponding to the infra red absorption band, while carbon dioxide gives two lines which correspond to the *differences* in frequency of the components of the doublet infra-red absorption bands[8]

Oxygen, hydrogen, and nitrogen scatter the exciting line with several equally spaced lines on either side, these are found to be due to changes in molecular rotational energy, with alternate rotational levels missing or relatively weak In oxygen the lines are due to transitions between odd levels only, in hydrogen the lines due to transitions between odd levels are strong, while those between even levels are weak, and in nitrogen the intensities are reversed[30] The difference between the three gases in this respect may be made clearer by the use of heavier type to indicate larger intensities

Oxygen	**odd**	
Hydrogen	**odd**	even
Nitrogen	odd	**even**

It is remarkable that in this respect nitrogen should be unlike hydrogen, for from the point of view of nuclear states one would expect them to be similar

In nitrogen monoxide a Raman line has been photographed corresponding to a change in the direction of electronic spin[31]

Oxygen, hydrogen, and nitrogen were first examined in the liquid state,[32] and in the case of hydrogen two quantum transitions in the molecular rotation were observed, and a one quantum vibrational transition The rotational transitions are $0 \rightarrow 2$ and $1 \rightarrow 3$, the molecules being in the zero vibrational state This is evidence of the existence of both the α and β forms in liquid hydrogen

SCATTERING IN LIQUIDS

The effect was first discovered with liquids, and it is with the scattering material in this state that most of the work has been done With the exception of the work on liquefied gases just mentioned, the results obtained with liquids have been important more with regard to the infra red spectra and chemical constitution of the material than to the elucidation of the effect itself It would be impossible here to refer to many of the papers dealing with liquids, a comprehensive memoir has lately been published by Ganesan and Venkateswaran[33]

As an example of the use of the effect for the study of chemical constitution we may consider the C-H bond This bond is found to involve a Raman shift corresponding to 3 35 μ in tetrachlorethane for example, but when the carbon has a double bond, the C H line is displaced towards the shorter wave-lengths, for example, 3 25 μ in trichlorethylene[34, 35] In a similar way other Raman shifts are connected with chemical linkages In

the instance just quoted, Raman effect measurements are supported by infra red observations, unsupported evidence should be treated with caution, since Raman shifts correspond so frequently to the difference between frequencies rather than to the frequencies themselves

Solutions of salts in water show Raman lines characteristic of the salts in addition to those due to the water As an example of work on solutions may be quoted the recent interesting experiments of I R Rao with nitric acid at different concentrations[36] Lines were found with the concentrated acid, due to the NO_3 ion, as well as lines attributed to HNO_3 On dilution, the NO_3 lines intensified up to a maximum and thereafter diminished in intensity, while the HNO_3 lines progressively grew weaker and faded out altogether The dilution at which the HNO_3 lines disappeared was the same as that at which the intensity of the NO_3 lines was a maximum Thus, literally an ocular demonstration is provided of the increase of ionisation in a solution when it is made more dilute

SCATTERING IN SOLIDS

Quartz and iceland spar were investigated by Landsberg and Mandelstam,[37] who claim to have discovered the effect independently of Raman one of the shifts found by them in Iceland spar corresponds to the optically inactive fundamental frequency of the CO_3 ion Such inactive frequencies occur with great strength in the Raman effect in crystals, they may be observed easily using the crystals as a coarse powder, or in solution

When water of crystallisation is present, the water Raman lines are found, and are considerably sharper than in water itself

Raman lines corresponding to the residual ray frequency of rock salt are *not* found, nor do the residual ray frequencies appear in the Raman effect investigation of lithium or sodium fluoride Schaefer[38] suggests that the Raman effect implies an asymmetrical vibration, while the lattice vibration of NaCl is essentially a symmetrical vibration

THEORY

The original theory as put forward by Raman was that the modified lines were displaced by an energy amount equal to that required to raise a molecule from the normal state to some higher energy state If this were so, all Raman lines would correspond to infra-red absorption lines, and this is certainly not the case The modified lines are implicit in the Kramers Heisenberg[39] dispersion formula, which was developed from the theory of Smekal[40] The existence of the effect was nevertheless not sought for, and remained to be discovered quite independently

The modified lines differ in frequency from the exciting lines by an amount equal to a difference in frequency between infra red absorption lines The absorption lines themselves may appear, but they are usually very weak Three levels are involved in the production of a single Raman line, say k, l, and n If transitions may take place between k and n, and between l and n, then a Raman line may be expected corresponding to the transition between k and l, even though this may be a forbidden transition in the infra red[3, 41] Thus it is at once explained why Raman lines exist having no counterpart in the infra red, and vice versa As the energy of the exciting quantum approaches the value $(E_n - E_k)$, the Raman scattering becomes increasingly intense, and when it reaches it, fluorescence occurs[42]

The theoretical explanation of the polarisation of the lines is not yet fully understood Raman has sought to explain it in terms of the optical anisotropy of the molecule,[12] while I have endeavoured to picture it in terms of the energy transitions between directions of vibration which have different orientations in the molecule[27]

FUTURE PROGRESS

Although a great deal has been done, much remains for investigation The polarisations of the lines, the relative intensities of the Stokes and anti Stokes lines, and the energy levels of molecules deduced from the Raman effect observations combined with infra red work, are a few of the lines of investigation which will provide work for many investigators There is little doubt that when its usefulness is appreciated, it will be constantly employed by the research chemist

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The *Transactions* of the Faraday Society dealing with the conference on molecular spectra, just published, contains several papers dealing with different aspects of the Raman effect.

Malaria Prophylaxis in Kenya.[1]

IN the years 1925, 1926, 1927 there were in Kenya at least 10, 10, and 5 deaths, and in Uganda at least 19, 48, and 22 deaths from blackwater fever in the respective years This is a deplorable waste of life, for it may be regarded as axiomatic that malaria and blackwater fever are so closely connected that freedom from the former means absolute freedom from the latter Blackwater fever to-day in Africa, as it did nearly a century ago, kills twenty-five in every hundred of those attacked, and yet, says Col S P James in the report before us, "Several people told me, with obvious pride, that they had had two or more attacks of the latter disease" [blackwater] (p 24) This century long waste of life, in spite of the "obvious pride" of the ignorant, is a totally unnecessary sacrifice It is unnecessary because malaria (and so blackwater) is a preventable disease, but now we are rejoiced to hear that this slaughter will cease in Kenya, for "the Governor had announced that it was his Government's intention to stamp out the disease" (malaria) With it will also disappear blackwater not only from among Europeans but also from among the Indians, of whom there are three times as many in Kenya as there are Europeans, and among whom the incidence and fatality of blackwater is surprisingly high (p 29)

Now "although the Kenya Government had taken various measures within the limits imposed by financial considerations and available staff, the disease [malaria] was still a serious menace" (p 5) Col James points out that the campaign (now to be undertaken) will be long and difficult, it must, in the words of H R H the Prince of Wales, be "intensive and scientifically conducted" How far these conditions are compatible with financial considerations remain to be seen So recently as 1926, Mr Ormsby Gore[2] stated "that malaria can be controlled is well known, but the difficulty and expense of such control, in view of the extent of the West African colonies and the conditions which prevail in those territories, are almost insuperable" (p 67)

Whether or no we can stamp out malaria remains to be seen, but if we try to do so, we should at least use the best methods available It is true that malaria has been 'stamped out' (we ourselves prefer a less ambitious word, 'moderated') here and there in various parts of the world, but it is unfortunately also true that no general wide spread success has attended the efforts of sanitarians Perhaps a clue to the whole situation is afforded by the example of malaria in Great Britain itself Ague has disappeared from the country Perhaps the most satisfactory explanation is that it has disappeared as the result of improved social hygiene Poverty, dirt, malnutrition, ignorance, have been replaced by wealth, cleanliness, well-being, and education to such an extent as to mitigate completely its ill effects Drainage and agriculture and improved housing also play their part Whatever be the exact cause, malaria for all practical purposes disappeared long before antimalarial campaigns were heard of, nor is this an entirely exceptional occurrence

Col James in this report lays great stress again on the view, so ably defended by him, that the methods of malaria prophylaxis are not simply those of the 'Aquatic school' (pouring paraffin on pools), or of the 'Mithridatic school' (poisoning the parasite with potions), if we may use these terms without disrespect, but that while both these methods have their (limited) usefulness there is something more, namely, the great malaria problem is one of social hygiene in its widest application and that mere prophylaxis as usually carried out is not likely to succeed until this is realised Poverty then must be stamped out by wealth, and ignorance by knowledge, malaria also will be stamped out in the process The practical advice given in this report will be of great value to those directly concerned with the actual administrative problems that arise in such a vast undertaking and high aim as the Kenya authorities have in view

J W W S

[1] Report on a visit to Kenya and Uganda to Advise on Antimalarial Measures By Col S P James Pp 48 (London Crown Agents for the Colonies 1929) 1s

[2] Report by the Hon W G A Ormsby Gore (Parliamentary Under Secretary of State for the Colonies), on his visit to West Africa during the year 1926 (London H M Stationery Office)

Obituary.

PROF KARL VON DEN STEINEN

BY the death of Karl von den Steinen on Nov 4 last, ethnological studies in Germany have lost one of their most distinguished and widely known representatives Born at Muhlheim a Ruhr in 1855, he graduated at Düsseldorf in 1871 and studied medicine at Zurich, Bonn, and Strasbourg While travelling round the world from 1879 to 1881, he met Adolf Bastian in Hawaii Association with that distinguished and enthusiastic ethnologist turned his attention to the study of primitive cultures, especially those of Polynesia.

It was not, however, until 1884, after his return from South Georgia, where he had been attached to the German party in charge of the meteorological station, that von den Steinen definitely turned to anthropological exploration He then organised an expedition through Central Brazil and explored the then unknown region of the Xingú, one of the southern tributaries of the Amazon The results of this expedition were embodied in his book "Durch Zentral Brasilien" He returned to the Xingú in 1887, publishing the results of his intensive studies of the natives of the area in his grammar of the Bakairi language in 1892, and in his "Unter den Naturvölkern Zentral Brasiliens" in 1894

For long von den Steinen was best known to the

outer world for his work in South America, but his interest in the culture of Polynesia never flagged In 1897 he visited the Marquesas and in 1898 the tribes of north western Canada His studies in Brazil had interested him in the problems of primitive art, and this interest was intensified by the curious art forms of the Marquesas From this time forward he devoted himself to the accumulation of material for the study of the history of Marquesan art The result was his monumental work on Marquesan art, of which the first volume appeared in 1925 and the second in 1928—a work which cannot but have a profound effect on method in all future studies of primitive art

Von den Steinen's life was devoted to research, but he held a chair in the University of Marburg from 1891 to 1892, was president of the German Geographical Society in 1896, director of the South American department of the Ethnographical Museum in Berlin from 1902 to 1906, and president of the Anthropological Society of Berlin from 1908 to 1910 He was elected an honorary fellow of the Royal Anthropological Institute so long ago as 1905

Prof Auguste Rateau

With De Laval, Sir Charles Parsons, Curtis, and Ljungström, the late Prof Rateau, who died in Paris on Jan 13, will be remembered as one of the successful pioneers of the steam turbine So long ago as 1890 he published his "Études sur les turbines à vapeur", in 1896 he patented his well known form of multi stage impulse turbine, in 1900 at the Paris Exhibition he exhibited complete designs for a turbine installation of a torpedo boat, and in 1903 he founded the Société Rateau, which from small beginnings rapidly grew into a large undertaking employing some three thousand workmen, with branches in all European countries Though the turbine claimed the greater share of his attention, he did most successful work on the compound centrifugal air compressor, while his turbine super-charger has been fitted to aero engines and to marine Diesel engines

Born at the small town of Royan, near the mouth of the Gironde, on Oct 13, 1863, Rateau attended the grammar school at Cognac and then spent some years as a student, first at the École Polytechnique and then at the École Supérieure des Mines in Paris, gaining the rank of Inspector of Mines in 1886 He was already distinguished by his high attainments, and in 1888 was appointed a professor at the Mining School at St Étienne, about ten years later he returned to Paris as a professor of electrical engineering in the École Supérieure des Mines

It was Rateau's early work on mine ventilation which laid the foundation of his work on turbines and turbo blowers Of world wide reputation, he read papers in England to the Institution of Mining Engineers, the Institution of Naval Architects, and the Institution of Mechanical Engineers, and during the James Watt centenary celebrations in 1919, with other distinguished engineers, received the honorary degree of LL D from the University of Birmingham He was likewise honoured by places so far apart as Charlottenburg, Wisconsin, and Louvain, while he was one of the few engineers to be elected a member of the Institut de France

We regret to announce the following deaths

M Maturin L Delafield, originally of New York, who for the last twenty five years has resided in Lausanne, known for his work on the taxonomy of vascular plants and on phytogeography, on Dec 18, aged sixty years

Mr E T Newton, F R S, formerly palæontologist to the Geological Survey of Great Britain, on Jan 28, aged eighty nine years

Dr J M D Scott, professor of physiology in the University of Saskatoon and formerly lecturer and senior demonstrator at St Bartholomew's Hospital Medical School, London, on Jan 28

News and Views

The centenary of the birth of Lord Salisbury, who delivered a noteworthy address as president of the British Association at the meeting at Oxford in 1894, fell on Feb 3 last It is interesting to recall that, for a great part of his life, scientific experiment was the favourite occupation of his leisure hours In the earlier phases of this hobby, his interest lay in the direction of chemistry, especially as applied to photography, in that stage of its development when the amateur had to be a good deal more independent of expert assistance than he is to day In the biography written by his daughter we are told that, in addition to the camera and tripod, "the paraphernalia of bottles and trays and red lamps and sheets of unsavoury velvet were, at this time of his life, a constant accompaniment in holiday travelling" We are also told that "his wife shared in the painful experiences familiar to relatives of self educating chemists", and that on one occasion he staggered into her presence and fell fainting at her feet, as the result of a too successful manufacture and inhalation—of chlorine. At a later period, when increased means brought more expensive apparatus within his reach, he turned from chemistry to electricity, and in his laboratory at Hatfield spent his leisure on prolonged and minute experiments, at first on problems of polarisation and magnetism, and later on certain spectroscopic phenomena On the latter he published a paper in the *Philosophical Magazine*, and in a German handbook on the subject they are mentioned as the first in point of time in which the conclusion was drawn that a gas at low temperature could emit a bright spectrum

Of Lord Salisbury's work at Hatfield an account written by his friend and helper, Prof H M'Leod, shows him "repeating, checking, analysing, with as much patience and enthusiasm as if such work had been the occupation of his life" There is no disposition on the part of his biographers to claim or to suggest that he would have attained high eminence as a

scientific worker had he adopted science rather than politics as his life work, on the contrary, he was so deficient in the instinct for external observation—to the extent of being on one occasion unable to recognise a colleague in the Cabinet when he saw him—that, as his daughter puts it, "it is difficult to believe that he could ever have acquired that power of recognising unlooked for phenomena among the accidental by products of an experiment to which so many discoveries have been due" But it is easy to understand his addiction to scientific experiment, with its promise of some definite result, as a restful contrast to the inconclusiveness and lack of finality in politics

A BILL for the Protection of Wild Birds in Scotland was introduced in the House of Commons on Jan 23, and obtained a first reading The bill repeals the present laws relating to wild birds, other than game birds, and substitutes a simplified code the essence of which is that all birds and their eggs are to be protected at all times, with a few exceptions The apparent simplicity of such a measure is sure to appeal to unthinking minds, but the principle of the bill is unscientific Equally to protect all birds is in reality to favour the stronger and more successful as against the weaker It has been forgotten that man, with his cultivation and industries, has irretrievably upset the balance of wild Nature The best he can now do is not to perpetuate this upset balance, but so to regulate numbers and species that so far as possible none should suffer unduly from his original interference It would be easy to cite cases where already overmuch protection has resulted in the increase of certain species at the expense of equally or more desirable birds The bill has other defects In some respects it is unnecessary legislation, for it protects many birds which require no protection It would make the schoolboy who takes a blackbird's egg a criminal Even more curious, while preserving intact all the laws which conserve game birds for the wealthy, it makes serious inroads against the old-established right of the ordinary man to obtain, if he can, an occasional meal on the seashore It is unlikely that such a bill will pass unchallenged at its second reading, which is put down for Feb 10

So little notice is taken by the public Press of Great Britain of the award of Nobel prizes, except the prizes for literature and peace, that the banquet given on Feb 3 by the Biochemical Society in honour of the Nobel Laureates in medicine and chemistry last year is of particular interest In Sweden the prizes are rightly regarded as of outstanding and world wide importance, and when they are presented on the anniversary of Alfred Nobel's death, the head of the State is present, and the ceremony is conducted with impressive solemnity and dignity The Swedish people show that they are proud of the great foundation with which Nobel entrusted them, and the nation delights to associate itself with the progressive thought and work of the recipients of the prizes. British Laureates find a very different atmosphere prevailing when they return to their own shores; and it is not surprising to know that this public indifference is not understood in Sweden. The banquet on Monday will, we hope, show that scientific people, at any rate, realise the high distinction conferred by the Nobel awards The three Laureates in medicine and chemistry who were present were Sir Frederick Gowland Hopkins, Prof Hans von Euler, and Prof Arthur Harden Prof C Eijkman was unfortunately unable to attend, owing to ill health

SIR CHARLES MARTIN presided at the banquet, which was largely attended, among the company being the Swedish Minister and Sir Ernest Rutherford, president of the Royal Society In proposing the toast of "The Nobel Laureates", Sir Charles Martin gave a very interesting survey of the growth of knowledge of accessory food factors from the time when Eijkman became director of the pathological laboratory at Weltevreden to the present period of marvellous activity Beri beri was then regarded as an infection, and it was Eijkman's experiments which showed that the disease was similar to a disease in fowls and due to a dietetic deficiency Turning to Sir Frederick Hopkins, the chairman hailed him as a prince of biochemists who has enriched physiology for forty years by his discoveries From his experiments with synthetic diets he was led to conclude that for nutrition certain minute quantities of hitherto unknown substances were essential, and so began our knowledge of vitamins Prof Harden's researches began with the fermentations of bacteria by accurate quantitative methods, and developed into his brilliant work on alcoholic fermentation His discoveries have brought about completely new conceptions of the chemistry of these changes Prof von Euler's explorations in the same field have been most extensive, and there is scarcely any aspect of the subject that he has not illuminated by his researches

MANY British botanists realised anew, during the British Association meeting in South Africa last year, the very interesting nature of the vegetation of South and East Africa and of Rhodesia Between November 1928 and March 1929, Dr T F Chipp, assistant director of the Royal Botanic Gardens, Kew, was travelling in the Anglo Egyptian Sudan and, as a result, presented to the Royal Geographical Society on Jan 13 an interesting account of the vegetation features of this West African botanical region Vegetation belts of very different character are found, lying at varying distances from the Gulf of Guinea and ranging from the luxuriant development of vegetation in the south west area, favoured by the monsoon from the Gulf, to the desert vegetation to the north east in an area desiccated by the north-east Trades from the continent of Asia Whilst climate, therefore, plays an all important rôle in determining the distribution of vegetation, biotic factors, as exemplified by man, may play a very important part in two ways, which seem of fundamental importance from the Cape to Cairo, namely, shifting native cultivation and the burning of the dry grass and bush lands

MAJOR CHIPP, with his experience both of vegetation and of problems of agricultural and horticultural significance, discussed one administrative problem

that deserves examination He pointed out that the political units in Africa are by no means natural vegetation units Each big British territorial unit cuts across a number of the natural belts of vegetation, and so independently, in each territory, as scientific investigation begins to precede further agricultural exploitation, the same problems are taken up afresh by different investigators at different, and very isolated, centres This would not matter if the men and money available were unlimited, but this is very far from being the case As Dr Chipp said "no one country can afford to maintain a staff of specialists sufficient to deal with all the food crops and crops of commercial importance which occur within its boundaries, and the inevitable tendency is for a few individuals in each country to attempt research into vastly different problems" Such a dissipation of our very limited available scientific resources will certainly prove wasteful Possibly, as the new tropical research centre at Amani, in Tanganyika Territory, gets into its stride, we shall see a better co ordination and utilisation of the efforts of a widely scattered body of scientific workers, whose labours should certainly be utilised to best advantage if the tropical resources of the Empire are to be tapped at a pace in any measure commensurate with our needs

THE esteem in which the late Ernst Abbe was held by his countrymen is well illustrated by the fact that, twenty five years after his death, *Die Naturwissenschaften* devotes more than half its issue of Jan 17 to an account of his connexion with the firm of Zeiss, written by Dr H Hartinger Most of the facts are already known from the "History" by Prof von Rohr, but they furnish a romance of science which still bears repetition Carl Zeiss, after learning his trade as an instrument maker at Weimar and working in Vienna, Berlin, and other towns, established himself in 1846, at the age of thirty, as instrument maker to the University of Jena His experience convinced him that great improvements in the microscope were possible, and in 1866 he took into his works Ernst Abbe, a mathematician of twenty six years of age, trained at the University and clever with his hands, and the firm began to construct instruments with Abbe's improvements When, in 1870, their progress was stopped by the want of glass with new properties, they called in Otto Schott, and with the aid of a grant of £3000 from the Government, established the Jena glass works in 1884, proceeded to make the glass required, and in this way produced their apochromatic objective in 1886 Carl Zeiss died in 1888, and his son retired in 1889, leaving Abbe the sole head of the firm Much of the work now fell on the shoulders of Abbe's assistants, Rudolph, Czapski, and von Rohr, and in 1903 he gave up scientific work He died two years later A statue of him by Hildebrandt stands in the hall of the University of Jena, and views of this and a smaller one by Hischen are reproduced in the article An indifferent photograph of Abbe in 1886, a good one of Zeiss in 1883, and a drawing of the house in which he lived in 1834–38 are also reproduced

THE regulations of the Post Office with regard to broadcast licences in Great Britain have been subjected to criticism, some of which is discussed in the *Wireless World* for Jan 29 In particular, a Post Office regulation states that "The Licensee shall not use or allow the station to be used for the receipt of messages other than messages intended for receipt thereby or sent for general reception" Listeners, therefore, who take pleasure in picking up the messages sent out from Croydon air port to aeroplanes flying between England and the Continent have a guilty feeling that they are breaking the law One of them, Mr Cyril E Baron, during the recent gales, picked up SOS calls from a ship in distress in the Channel Finding that the calls were not being answered, he communicated the information by telephone to the North Foreland Radio Station, and by this action was probably the means of saving the ship and the lives of those on board For this action, presumably illegal, he was duly thanked by the Post Office instead of having his licence cancelled The Post Office cannot hope to prevent listeners on radio receiving sets overhearing messages which it is desired to keep secret Those who are expert at the Morse code occasionally are interested in the messages they hear from ships at sea As a general principle, it is not advisable to publish regulations which cannot be enforced

LORD RAYLEIGH discussed, in his Friday evening discourse delivered at the Royal Institution on Jan 31, "Iridescent Colours in Nature" The colours of insects, said Lord Rayleigh, are of two distinct classes Some of them are due to pigmentary substances, for example, the tortoiseshell butterfly owes its red colour to pigments, and accordingly the red colour is seen by transmitted light On the other hand, blue butterflies apparently never owe their colour to a pigment, for example, in *Morpho Rhetenor*, the blue colour seen so brilliantly by reflection disappears entirely by transmitted light, a nondescript brownish colour being alone perceptible The experimental evidence leads to the view that the blue butterfly owes its colour to interference of light, the reflection at the front and back surfaces combining to give this interference for the less refrangible parts of the spectrum, and leaving the blue as a residuum The colours of metallic beetles are of special interest and have excited considerable controversy Some authorities attribute them to the surface reflection of intensely absorbing matter assumed to be present in the wing case, and in fact to be analogous to the surface reflection of aniline colour Lord Rayleigh held that this view presents insuperable difficulties First, the colour by absorption is not saturated, as it always is in the case of substances known to give surface reflection Secondly, the colour of the reflection changes greatly with the angle of incidence, while surface reflection colours do not Lastly, when the spectrum is examined by absorption, it is found that bands are present which can be identified as essentially the same over different parts of the specimen, but vary slightly in position The colour seems to be due to interference in this case also, the peculiarities of the

reflection and also of the absorption being due to the presence of a large number of reflecting layers suitably spaced

Prof J L Myres's presidential address to the Royal Anthropological Institute on "Anthropology, National and International", which was delivered at the anniversary meeting on Jan 28, was a valuable survey of the movements during the last century to promote intercourse between men of science within their own country and internationally Of these the British Association, which will celebrate its centenary next year, is a noteworthy example In the international field, anthropology appeared early with the International Congress of Archæology and Prehistoric Anthropology, which first met in 1864 and continued to meet at more or less regular intervals up to 1912 At Geneva in that year it was decided that the next session should be held in Spain in 1915 The War intervened and the meetings have never been resumed, although an attempt was made to hold a congress at Madrid in 1927, which fell through after the preliminary arrangements had been made

The present position in regard to an international congress of anthropology is one of considerable difficulty, of which the facts are admirably summarised by Prof Myres's address At the close of the War, our French allies, among their praiseworthy efforts to reinstate international co operation in intellectual affairs in accordance with the intention of the treaty of Versailles, founded an Institute of Archæology in Paris to which the title of 'International' was given One of the objects of this Institute was the promotion of international congresses in archæology and anthropology Several such congresses have been held at triennial intervals, beginning with that at Liège in 1921 But, as Prof Myres showed, whatever may have been the case in the period immediately after the War, a congress organised in conditions at present inseparable from the constitution of the French institute can no longer comply with the requirements of a congress which is truly to be regarded as international The problem, though difficult, should not be insoluble It appears essentially one for which a solution might be found through the International Research Council

The relationship between the engineer concerned with petroleum and the industry itself is not easy to define It is usually clouded by argument as to whether the engineer made the oil industry or the industry the oil engineer It is further complicated by lack of agreement as to what really constitutes the engineer in the oil industry, since according to circumstances and national custom the designation may imply anything from a raw driller's assistant to the highly trained and technically qualified consultant This would seem *prima facie* a case for a formula, but Mr John Gillespie's discursive paper on the subject at the Institution of Petroleum Technologists on Dec 10 cannot be said to have supplied one If one takes the stand at the outset that "the engineer *is* in the forefront, and forms, and will always form, the spearpoint in this line of attack upon the resources which Nature has hidden ", then obviously the engineer made the oil industry and the relationship becomes practically parental

We would remind Mr Gillespie, however, that in many instances the geologist might legitimately claim to be in the forefront of the attack on oil resources that it is due to his initial efforts that the engineer is led to the scene where his "spearpoint" will prove most effective On the other hand, there are equally cases where the engineer, either because he has no use for the geologist or because he believes more fervently in his own judgment, occupies the front line from the start The early history of development of the industry is full of examples of the triumphs of pioneers of this kind, and to them all honour is due But in latter days, oilfields are not so easily located, those that formerly were 'there for the asking', so to speak, are now worked out, and new discoveries are more and more determined by intensive technical effort, to the inevitable displacement of the old time oil engineer The vocation of the petroleum engineer to day is entirely professional and specialised, in some countries he is both geologist and civil engineer, in others, he is fundamentally the engineer responsible for winning the oil successfully from the pool, and his geology is second hand The driller is the mechanical engineer on the field he is not a geologist and never will be The matter will for long continue to be contentious, but it will scarcely be helped to settlement by exaggerated claims for one individual or the other

Sir Douglas Mawson announces further discoveries in the Enderby Land region of Antarctica in messages to the *Times* After finding that Enderby Land extends to the south west in long 46° E, he turned eastward and passed in lat 66° 22′ S, long. 48° 30′ E, the tip of a great ice shelf walled by 200 feet ice cliffs This ice shelf extends south east to join the land It is evidently comparable with the Termination and other floating ice shelves already known and is responsible for many of the large tabular bergs already reported in the neighbourhood About three degrees farther east the land faces the sea in a rocky height of 1500 feet on which antarctic petrels and other birds were nesting Several aeroplane flights have facilitated exploration The ice plateau of Enderby Land seems to rise in the interior to about 4000 feet and there are many nunataks protruding through the ice On one flight no less than 73 were visible at one time, one of them being 7000 feet in height The *Discovery* is now short of coal The Norwegian expedition in the *Norvegia* was last reported to be moving westward from Enderby Land carrying out oceanographical researches An aeroplane is being used for coast exploration and reconnaissance of ice conditions

Psittacosis or parrot fever has lately been much before the public The disease is primarily one attacking parrots and some other birds, and is contracted by close association with sick birds In man it causes a fever of a septic or typhoid like type with bronchitic or pneumonic complications, and severe cases are rare,

though milder forms may be more frequent and be mistaken for other maladies A considerable epidemic was reported in Argentina last July, and according to a *Daily Science News Bulletin* issued by Science Service, Washington, D C, 38 cases have recently occurred in the United States The disease has been attributed to infection with *Bacillus psittacosis*, a micro organism first isolated from Parisian cases by Nocard in 1893 and very similar to, or identical with, *B aertrycke* of food poisoning This organism does not appear to have been found in the recent cases investigated, and Bedson, Western, and Simpson, in the *Lancet* of Feb 1, p 235, suggest that it may prove to be a secondary infecting agent, and that the disease may be caused by a filter passing virus

MR F TWYMAN will deliver his presidential address to the Optical Society at the meeting to be held at the Imperial College of Science and Technology, South Kensington, on Thursday, Feb 13, at 7 30 P M The subject of the address is "Optics in Radio Transmission and other Fresh Fields"

SIR HAROLD HARTLEY, fellow and tutor of Balliol College, Oxford, and distinguished for his work in physical chemistry, has been appointed a vice president of the London, Midland and Scottish Railway Co in succession to the late Mr R W Reid, and also director of scientific research to the Company

LIEUT COLONEL THE RIGHT HON WALTER E GUINNESS, M P, has been elected president of the Marine Biological Association of the United Kingdom in succession to the late Sir E Ray Lankester Colonel Guinness was Minister of Agriculture and Fisheries in the recent Conservative Government

MR A H G ALSTON has been appointed Assistant Keeper in the Department of Botany, British Museum (Natural History), where he will be in charge of Pteridophytes Mr Alston was formerly systematic botanist to the Department of Agriculture, Royal Botanic Gardens, Peradeniya, Ceylon

MR G S GORDON, president of Magdalen College, Oxford, Prof O W Richardson, director of research in physics, King's College, London, and Mr H T Tizard, Rector of the Imperial College of Science and Technology, have been elected members of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public service

IT is announced in *Science* that the Edison medal, awarded by the American Institute of Electrical Engineers for "meritorious achievement in electrical science, electrical engineering, or the electrical arts", has been conferred on Dr Charles F Scott, professor of electrical engineering at Yale University, who was president of the Institute so long ago as 1902, for "his contributions to the science and art of polyphase transmission of electrical energy"

THE council of the Institution of Naval Architects has awarded the Gold Medal for the year 1929 to Mr John Johnson, chief superintendent engineer of the Canadian Pacific Steamship Line, for his paper "The Propulsion of Ships by Modern Steam Machinery", and the Premium to Lieut Col F Dondona, for his paper "Sea Trials of Italian Destroyers" The medal and the premium will be presented at the opening of the annual general meeting, which will be held on April 9 at the Royal Society of Arts, John Street, W C 2

APPLICATIONS for the Government grant for scientific investigations must be made upon forms obtainable from the Clerk to the Government Grant Committee, Royal Society, Burlington House, W 1, and returned not later than Mar 31

THE annual general meeting of the Institute of Metals will be held in the Hall of the Institution of Mechanical Engineers on Mar 12 and 13 The president is Dr W Rosenhain, and the president designate, Dr R Seligman In addition to the reading and discussion of papers, members will be given facilities for visiting the Birmingham section of the British Industries Fair The May lecture of the Institute will be delivered on May 7 by Dr F A Freeth, joint research manager of Imperial Chemical Industries, Ltd

THE annual meeting of the Iron and Steel Institute will be held at the house of the Institution of Civil Engineers, Great George Street, London, S W 1, on May 1 and 2, under the presidency of Prof H Louis The autumn meeting this year is to be at Prague during the week beginning Sept 15, in response to an invitation from the Society of Czechoslovakian Engineers, in the house of which the meeting will be held As arranged in 1928, the autumn meeting for 1932 will be held in the United States, at the invitation of the American Iron and Steel Institute and the American Institute of Mining and Metallurgical Engineers

THE provisional figures of the birth and death rates and infant mortality for England and Wales during 1929 have been issued by the Registrar General The birth rate, 16 3 per 1000 population, is the lowest recorded, and is 0 4 below that of 1928 The death rate is 13 4 per 1000 population, which is 1 7 above that of 1928 The rise is practically confined to the first quarter of the year, and is due to the prevalence of epidemic influenza and to the severe weather in that period The same causes probably account for a rise in the infant mortality rate (deaths of infants less than 1 year of age per 1000 live births) from 65 in 1928 to 74 in 1929

THURSDAY last, Feb 6, was the centenary of Daniel Oliver, for many years Keeper of the Herbarium at Kew, and also professor of botany at University College, London He was born on Feb 6, 1830, at Newcastle on Tyne His work at Kew began in 1858 he retired from the Herbarium in 1890 and died in 1916 at Kew His official life was entirely devoted to his botanical work, and he was gifted with remarkable insight and a great habit of accuracy Oliver's unofficial life was largely given to art He worked in sepia, chalk, oil, and water colour It is proposed to hold an exhibition of his drawings at Kew this summer, the Director of the Royal Botanic Gardens has arranged for the show to be held in one of the

museums at Kew It is thought that this by-product of the life of a serious botanist may be of interest to both artists and scientific workers The works are of varied character and many are of great delicacy

THE recently issued catalogue (No 448) of Messrs Bowes and Bowes, Cambridge, contains the titles of upwards of 3000 works relating mainly to mathematics, astronomy, and physics It is of special interest because most of the volumes belonged to such distinguished men as the late Dr J W L Glaisher, James Glaisher, Prof G H Bryan, and Dr R A Herman The prices asked appear to be reasonable The catalogue can be obtained upon request

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —An assistant lecturer in biology in the Department of Education of the University College of the South West, Exeter—The Registrar, University College, Exeter (Feb 15) An instructor in commercial fruit growing and an assistant agriculturist under the Kent Education Committee—The Agricultural Organiser, Springfield, Maidstone (Feb 20) A part time master for mathematics at Willesden Polytechnic School of Building—The Principal, Willesden Polytechnic, Kilburn, N W 6 (Feb 22) Two appointments in the Forest Service of Burma—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S W 1 (Feb 24) A demonstrator in the Division of Bacteriology and Immunology of the London School of Hygiene and Tropical Medicine—The Secretary of the London School of Hygiene and Tropical Medicine, Keppel Street, W C 1 (Feb 24) Three research assistants in the Department of Coal Gas and Fuel Industries of the University of Leeds—The Registrar, The University, Leeds (Feb 24) A lecturer in chemistry and a lecturer in mathematics at Raffles College, Singapore —The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S W 1 (Feb 28) A histological assistant under the Joint Board of Research for Mental Disease, Birmingham—The Director, Joint Board of Research for Mental Disease, City and University of Birmingham, Hollymoor, Northfield, Birmingham (Mar 1) An advisory veterinary officer at the Seale Hayne Agricultural College — The Principal, Seale Hayne Agricultural College, Newton Abbot, Devon (Mar 1) A professor of pathology and bacteriology in the Veterinary College, Patna—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S W 1 (Mar 15) An experimental assistant at the Air Defence Experimental Establishment — The Superintendent Air Defence Experimental Establishment, Biggin Hill, near Westerham, Kent A technical officer in the Admiralty Technical Pool for service in an Admiralty Establishment at Portsmouth—The Secretary of the Admiralty (C E Branch), Whitehall, S W 1 Three research assistants under the British Cotton Research Association—Dr R H Pickard, Shirley Institute, Didsbury, Manchester A veterinary advisory officer in the Department of Agriculture and Horticulture of the University of Bristol—The Secretary, The University, Bristol

Our Astronomical Column

Comets —*Popular Astronomy* for January contains an enlargement (six times) of a photograph of Wilk's comet taken by Prof G van Biesbroeck at Yerkes Observatory on Dec 22 The exposure was for 20 minutes, the coma appears exactly circular, 20′ in diameter, its brightness is nearly uniform, but there is a slight fading at the edges A central condensation could be seen visually, but does not appear in the reproduction It is noted that a slender tail, pointing almost exactly opposite to the direction of the sun, can be traced through 20′ on the negative Prof van Biesbroeck also gives reproductions of the two plates taken by M Quénisset in Switzerland of Forbes's first comet on Oct 25, 1928, nearly a month before its discovery Prof van Biesbroeck has measured the enlargement of the first plate, and gives the following position of the comet, which he estimates to be trustworthy within 5″ 1928 Oct 25 1542 U T, R A $10^h\ 56^m\ 54\ 5^s$, N Decl 11° 32′ 3″ (equinox 1928 0)

The Central Solar Eclipse of April 28 next —This eclipse will be total for about 1½ seconds in the western parts of the United States of America It passes a little north of San Francisco and runs from there in a north easterly direction *Popular Astronomy* for January states that the Lick Observatory is sending an expedition to Camptonville, California, under Dr Moore its work will be mainly spectrographic, and Dr Menzel will try to photograph the flash spectrum Dr Aitken states that an attempt will also be made to obtain at least one photograph of the corona three observers with cameras will be stationed at intervals of ¼ of a mile along a line at right angles to the central line, as there is inevitable uncertainty of at least this amount in the prediction of that line This is one of the eclipses that, though 'invisible at Greenwich', is visible in portions of the British Isles A small partial eclipse will be visible before sunset over the whole of Ireland and the northern part of Scotland

The Grootfontein Meteor —*Popular Astronomy* for January contains an account of this enormous meteor by Dr W J Luyten, who made the long journey (1550 miles) from Bloemfontein to Grootfontein in order to study it Several photographs of the meteor are reproduced It is roughly rectangular in shape, about 10 ft by 9 ft, and the thickness at the sides varies from 2½ ft to 4 ft Analysis of portions of it indicates that it is about one sixth nickel, the rest nearly pure iron Its specific gravity may be estimated as 7 3, and its mean thickness as 3 2 ft its mass in tons would then be roughly 58 7 tons it cannot be much less than this, but may be more if there is a 'nose' in the middle of the base It is probably the most massive meteor known, that brought by Peary from Greenland weighed 36 5 tons Dr Luyten, who removed a small fragment, noted that it was as hard as the hardest steel He states that the existence of the meteor has been known in the neighbourhood for "a considerable length of time", but no record of the date of fall is mentioned He also mentions a valley "east of Gibeon" that contains a number of smaller meteors, weighing about 500 lb each, but these have been known for a long time They contain less nickel than the great meteor —only 7 or 8 per cent

Research Items

Plant Remains in Sun-dried Bricks—Prof George W Hendry, of the University of California, looking for the source of the black oats grown in Sonoma County, California, noticed that adobe bricks contain well preserved specimens of vegetation Since that time, 14 sun dried brick buildings in different parts of California have been examined, and whilst not one sprig of black oats has been found, many interesting data have been obtained as to plant introductions and were reported by Prof Hendry at the meeting of the American Association for the Advancement of Science at Des Moines in December last (*Daily Science News Bulletin*, Science Service) The approximate dates of introduction and sources of many plants and weeds, however, have been accurately determined from a careful study of the ages of the buildings in which they occur In spite of the fact that much of this vegetation has been embedded in the clay for more than a century and a half, it is still preserved well enough for identification Contrary to popular belief, it has been definitely established from these finds that wheat was introduced into California during the Spanish period Barley has been found in 12 of the 14 missions examined, which shows that its culture lasted from 1701 to 1837 Only one kernel of wild oats has been discovered, and that was taken from the pulpit stair of the old church of the Mission of San Juan Bautista It is thought that the present wide dissemination of wild oats in California has occurred since 1837 Remains of garden crops, ornamental plants, fruits and fibre plants taken from the sun made bricks have also been identified

The Gaits of Quadrupeds—Having already analysed in a lengthy and detailed monograph the motions and limb stances of galloping animals, P Mayne de la Croix has now turned his attention to the elucidation of the laws which he thinks rule the evolution of locomotion in the vertebrates (*Anal Soc Cient Argentina*, t 108, p 383, 1929) A long series of observations leads him to postulate the great law of the evolution of quadrupedal locomotion as follows Progression takes place from the alternate use of quadrupedal and tripedal stances to the sole use of unipedal stances, and this evolution is made possible by means of a discord, always increasing, between the period of the swing of the anterior and that of the posterior Further, he finds that, just as in rapid gaits times of suspension are intercalated, when the animal is entirely free from the ground, so in slow gaits there are intercalated times of 'arrest' when the animal reposes upon all fours By this means are distinguished four great groups of gaits—reptilian creeping gaits, reptilian leaping gaits, walking gaits, and leaping gaits—and the author proceeds, aided by a series of figures of the successive poses in these types of movement, to trace what he calls the phylogeny of locomotion

Habits of the Manx Shearwater—Much acute field observation makes R M Lockley's account of the breeding habits of the Manx shearwater (*Puffinus puffinus*) of special interest (*British Birds*, vol 23, 202, 1930) The birds were studied upon Skokholm, a rock bound isle off the coast of Pembrokeshire, where some five thousand pairs breed Nesting burrows having been marked and traced to their end, a large sod was very carefully cut immediately over the nest, so that, when need be, this improvised window could be opened for observation Although shearwaters are nocturnal birds, spending the day in the farthest recesses of their burrows, it was found that while the nesting holes were visited nightly with great regularity, during the day one or both of the paired birds might be absent Both parents incubate the eggs, but one bird may sit for several days at a stretch, its only exercise being the turning of the solitary egg Probably during this period it is fed by its mate The passage of the young birds from the nest to the sea is attended by considerable mortality Most of the young at this stage still bear some of the down plumage, and since they are unable to rise on the wing except in face of a stiff breeze, they make an awkward and exhausting journey on foot across country if the weather be calm Should daylight find them still in the open, gulls and other marauders almost certainly destroy them The young which reach the cliff edge launch themselves straightway into the air, and flap downwards to the dark sea

Evolution of the Pelvis of Primates—Miss H C Waterman (*Bull Amer Mus Nat Hist*, vol 58, pp 585 642, 1929) has made a detailed study of the pelvic region of thirteen genera of Primates, with the purpose of determining the relation between the loco motor habits of the animal and the external form of the pelvis It was hoped thus to provide material of value in the attempt to separate habitus from heritage characters in these forms and to obtain some light on the evolution of the pelvis within the group The results of her studies lead Miss Waterman to support Gregory's views as to the main stages in the evolution of the pelvis from primitive arboreal quadrupeds to man These stages are (1) a primitive lemuroid stage, (2) the stage of the primitive monkey in which there are incipient adaptations for upright sitting, (3) the stage of the quadrupedal monkey in which adaptations for upright sitting are perfected, (4) the brachiating stage, and (5) the stage of bipedal man

Solution of Coral Reef Limestone—In the *Geographical Journal* for January, Mr W A Macfadyen describes the result of some of his observations on coral islands in the Red Sea His work was done on the Ashrafi and Jubal Islands at the mouth of the Gulf of Suez and on the Farsan Islands and Kamaran Island in the south east of the Red Sea These are practically all islands of reef limestone fringed with growing corals They project above a submerged platform and are fringed with shallow water which largely protects the coast from erosion by wave action The coasts are usually fringed by undercut cliffs The undercut may reach a depth of three or four feet The sharpened and roughened surface of the undercut suggests solution rather than wave action, which would give a smooth surface The presence of barnacles on miniature pedestals also suggests solution At the same time, Mr Macfadyen admits that boring and other organisms probably play some part in the formation of the undercut cliffs The small range of the tide confines action to a narrow depth and makes it more conspicuous

Physico-Chemical Phenomena in the Silkworm's Egg—The results of an investigation of the various chemical and physico chemical phenomena observed in the egg of *Bombyx mori* are described by Dr Mario Tirelli in the *Atti della Pontificia Accademia delle Scienze* (*Nuovi Lincei*) for 1929 It appears that the silkworm's egg is the seat not only of a morphological, but also of chemical and physico-chemical ontogenesis, which is to some extent independent of the first Embryonal development is accompanied by characteristic variations in the viscosity, cryoscopic

point, and amino acid content of the egg, which contains a proteolytic enzyme The liquid of the egg exhibits the power of undergoing stratification, which takes place in different manner with different strains and may be easily reproduced by adding toluene to the liquid and drawing the latter up into tubes The viscosity of the egg is characteristic of the race and, in the case of crosses, is sometimes intermediate to the values for the parental races, so that the male element also exerts an influence in modifying the physico chemical characters, and hence the chemism, of the egg

Studies on Tetrarhynchids —Descriptions of larvæ of *Tetrarhynchus* deal for the most part with external features and systematic characters The late Dr H Cammerloher (*Sitzungsber Akad Wiss Wien*, Mat nat Kl, 138 Bd, pp 125 143, 1929) describes the structure of the larva of *Anthocephalus elongatus* from cysts on the liver of *Orthagoriscus mola* All the specimens, which were obtained at Trieste, Naples, and Messina, had completely formed proboscides, younger stages were not found In the fresh liver the worms lie motionless in their cysts, but when the cyst is dissected in sea water, active rhythmic movements of the larva are observed which are also seen in specimens in the liver when the latter begins to decompose Larvæ preserved in extended condition are about 25 mm long After a brief account of the larva as seen in a whole mount, the author describes transverse sections through three different regions of the body and one through the tail appendage One of the most interesting points in the histology is that giant fibres are present in two of the nerves, seen in transverse section of the bothridial region, which innervate the muscle bases of the proboscides The muscle in the parenchyma in relation to the proboscides exhibits a spiral striation In the following paper Dr T Pintner describes the original example of *Diesingium (Rhynchobothrium) lomentaceum* Diesing, 1850, preserved in the State Museum in Vienna, from *Mustelus* taken at Palermo

Hyperfine Structure in Line Spectra —It is by now well established that there is a hyperfine structure to certain spectral lines which requires for its description an additional quantum number, and that the effect has its origin in the rotation of the nucleus The nature of the information which can be obtained from a study of this effect is well illustrated by two papers by H E White in the first December issue of the *Physical Review* The first of these deals with the spectrum of singly ionised praseodymium, data being given for the structure of 173 lines, all of which have six components spread over an interval of only about a quarter of an Ångström unit High spectral resolution is naturally needed to bring out such detail, and has been obtained in this instance by working in the fourth order of the 75-ft grating spectrograph at Mt Wilson, reproductions of the photographs obtained for ten typical lines are shown The praseodymium nucleus has been shown to possess an angular momentum of $\frac{5}{2}$ Bohr units, which compounds with the angular momentum of the outer electrons of the ion according to the usual rules of the quantum theory The second paper treats of the theory of the effect at greater length, with particular reference to the spectra of cadmium, bismuth, and lanthanum, and it is stated in a note that the theories advanced also fit in well with the structure reported by Prof McLennan and his collaborators for the spectrum of ionised thallium (Tl II), and with the author's own preliminary observations with manganese The same issue of the *Physical Review* contains a letter from S Goudsmit and R F Bacher on the subject of the Paschen Bach magnetic effect with hyperfine structure

Quenched Arc Switches —The large currents and the very high voltages now used in the networks distributing electrical energy have greatly increased the difficulty of breaking the supply in the event of a fault developing in a section of the network The problem of constructing an oil switch which breaks the current under oil has been solved up to a rupturing capacity (the product of the open circuit volts at the break and the short circuit current) of 800,000 kilo volt amperes When the switch contacts separate under the oil a high temperature arc ensues and a gas bubble is formed which rapidly increases in size even after the arc is extinguished In a medium sized switch the bubble may grow to be a foot in diameter and the gaseous pressure even when a large air chamber is provided may rise to 200 lb per square inch The energy evolved in a break depends on so many variables that it is impossible to predict accurately what will happen In a paper read to the Institution of Electrical Engineers on Jan 23 by L C Grant, the breaking performance of high power switchgear is discussed and a new form of quenched arc switch is described He quotes interesting results on the effects produced by oil switches which have one, two, or four breaks within them He concludes that the average 'distress' produced by the three kinds of switches are in the ratio of 100 62 50 With six breaks there seems to be only a slight improvement on the four break The size of the contact pieces and the speed with which they separate have a great influence on the performance of the switch The author insists on the necessity of manufacturers having high power available to test their switches A new quenched arc circuit breaker which he described measures six inches in diameter and six inches long and weighs only 28 lb, and yet it easily broke 50,000 kilovolt amperes at 6000 volts He stated that a device of this type could be constructed to break three million kilovolt amperes

Promoter Action —It is well known that the activities of many catalysts are enhanced by the addition of small amounts of other substances, called promoters In a study of the catalytic oxidation of methane with steam (*Bulletin of the Chemical Society of Japan*, October), Kuboto and Yamanaka have observed a relation between the type of reaction and the properties of the promoters They suppose that the reaction takes place successively in the following manner

$$CH_4 \xrightarrow{H_2O} CO + 3H_2 \xrightarrow{H_2O} CO_2 + 4H_2$$

The catalyst was nickel, and it was found that the largest quantity of carbon dioxide was obtained by using a catalyst promoted by Al_2O_3, whilst when water vapour was regulated the catalyst promoted with MgO gave the largest yield of carbon monoxide The effect of the promoters may be to transfer water molecules to the reaction centres of the catalyst where the action of water on methane is occurring, and the products will then be determined according to the capacity of the promoter to adsorb water molecules and also to the size of the promoter molecules The results are in good agreement with this hypothesis in the special form given to it by Balandin in a recent communication The reactions are assumed to occur in associations of reacting molecules called multiplets, and the two factors mentioned then come into consideration

Electrical Breakdown in a Solid Dielectric

IT is now well known that if we have two spherical electrodes in a gas, then in certain cases, over a very wide range of the distance between them, the disruptive voltage can be determined with great accuracy In computing this voltage, it is necessary to know first the nature of the gas and its temperature and pressure, secondly, the radii of the electrodes and the distance between them, and thirdly, the electric strength of the gas

The only problem that is laborious and difficult is the computation of the maximum electric stress between the electrodes When the electrodes are equal, these values can be found from tables well known to electrical engineers For example, when the electrodes are each one inch in diameter, the disruptive voltage in air can be computed with at least a one per cent accuracy at distances varying from one tenth of an inch to three inches, the corresponding voltages varying from about 10,000 volts to 50,000 volts When the spheres are closer together than a tenth of an inch, other physical factors have to be taken into account Everyday experience seems to show that there is a minimum sparking potential which is about 350 volts in air at ordinary atmospheric pressure and temperature

The early experimenters, only having a few thousand volts available, were naturally unable to find any simple law connecting sparking voltage and distance Kelvin, however, in his Reprint of Papers, pointed out so far back as 1860 that if we regarded the maximum electric stress as the determining factor, then it was 'most probable' that the numbers obtained in this way at higher voltages would be found to be sensibly constant, a surmise which has been rigorously proved in recent years by electricians

With electrodes in a gas, there are three cases which need to be considered separately First, when they are very close together, secondly, for distances apart up to about three diameters of either electrode, and thirdly, for greater distances when coronæ form before the breakdown discharge occurs It is very easy to calculate in the last case when the corona appears

In the *Journal of the Franklin Institute* for December, P H Moon and A S Norcross prove that in a solid dielectric there seem to be three different physical causes that lead to its disruption by electric stress The experiments were made on the lead glass of the approximately spherical bulbs of flasks Mercury inside the flask formed one electrode, and it was immersed in a bath of mercury which forms the other electrode This arrangement gets rid of the edge effect All the tests were made with direct current voltage obtained either from a hundred kilovolt kenotron set or a 4000 volt motor generator set

It was found, first, that for low temperatures and for low values of the thickness, the relation connecting the breakdown voltage with the thickness of the glass is a linear one Secondly, for higher temperatures and greater thicknesses, the breakdown voltage is no longer independent of the temperature but decreases as the temperature is raised Finally, when the temperature is raised above 150° C, the effect of temperature becomes much more pronounced and we reach the region of thermal instability which has been much studied by electricians Tests with sodium lime glass give similar results Apparently there is no connexion between resistivity and breakdown in the disruptive region Messrs Moon and Norcross consider that there are three distinct mechanisms of breakdown, the one that actually takes place depending on the temperature, thickness, and constants of the material

Transport of Stones by Attached Seaweed

MR SYMINGTON GRIEVE directed attention to the ocean transport of stones through the buoyancy of attached seaweed, with their consequent piling up as a stony beach where obstacles intercepted the ocean currents, in a paper in the *Transactions of the Botanical Society of Edinburgh*, vol 14, pt 2 (1882) This paper is reprinted in the *Trans and Proc Bot Soc*, vol 30, Part 2, 1929, together with further papers which give results of additional observations by the author since that time Charles Darwin discusses in "The Voyage of the *Beagle*" the transport of stones to Keeling Island and other atolls, through their attachment in the roots of floating trees, and it is interesting to learn that shortly before his death (Mar 22, 1882) he wrote to Mr Symington Grieve from Down a brief note that indicated his interest in the subject, in which he states that he had "long known that stones were transported by floating Fuci"

Probably almost every naturalist who reads these interesting papers will recall some observation from his own experience which might have enlightened him as to the buoyancy added to stones by the canopy of attached seaweed, but it has been left to the author to realise the significance such an apparently incidental occurrence may have, both in building up beaches of water worn rocks, in contributing to the erosion of the cliff surface by its bombardment by *Fucus* transported missiles in the waves, and even in contributing to the dislodging of massive masonry exposed to the waves and which, in time, has become covered with a canopy of seaweed Around the British Isles the seaweeds that contribute most in giving buoyancy to the stones on which they grow are *Fucus vesiculosus* and *Fucus (Ascophyllum) nodosus*, to a lesser extent *Fucus serratus* and *Chorda filum*

The author points out that the shape of the stone and the extent of the surface it exposes for the growth of the seaweed will be factors of importance in determining whether it is lifted from its bed by the tide, as also will be the amount of growth of the seaweed and the height of the water above it when under the influence of this tidal scour He has noted stones with seaweed attachment drifting along the bottom of the tide, so that the stones left a grooved trail on the bottom In the earlier paper it was pointed out how such a trail may be left on the sand or mud as the tide recedes, an alternative suggestion thus arising for some of the 'reptilian marks' or 'ripple marks' described for ancient or modern beaches

The author also raises the question as to whether the sargasso seaweed, composed of the two species *Sargassum vulgare* and *S bacciferum*, as it floats away from its breeding places upon the shores of the islands of Martinique, Guadeloupe, and Dominica, may not carry with it stones on its journey in the Caribbean Sea or the Atlantic or Pacific Oceans The late Prof James Chilton directed attention, in the *Transactions of the New Zealand Institute* (vol 56, pp 523 524), to the habit of the free swimming larvæ of an ascidian of attaching themselves to pebbles, which are thus lifted from gravel beds so that, in stormy weather, they are thrown up on the beach

Developments of Electrodeposition.

THE Electroplaters' and Depositors' Technical Society held its annual convention on Jan 31 at the Northampton Polytechnic Institute, St John Street, Clerkenwell, one of the features of the meeting being an exhibition representative of modern scientific and practical advances in electrodeposition This may be claimed to be the first exhibition devoted purely to the interests of the many phases of electro deposition ever held in Great Britain and is indicative of the big strides which have occurred in the technical development and the resultant commercial applica tions of the deposition of metals since the War The exhibition aroused great interest, and the subsequent meetings were attended by members and visitors from all parts of the country

The afternoon meeting was addressed by Dr W Rosenhain, of the National Physical Laboratory, Teddington, who discoursed upon "Research and Practice" In the evening, a discussion was held on the "Present Position of Chromium Plating", at which more than two hundred people were present, Dr R S Hutton, director of the British Non Ferrous Metals Research Association and president of the Electroplaters' and Depositors' Technical Society, being in the chair The discussion dealt with the practical aspects of chromium deposition

The exhibition was fully representative of practi cally every phase of the science and art of electro deposition Exhibits illustrated the application of electroplating for decorative (as in nickel and chromium deposition) and protective effect (as in the deposition of cadmium and zinc on ferrous metals), the 'building up' of worn parts by depositing iron or nickel and grinding afterwards to the required size, electrotyping and galvanoplasty, deposits being shown upon such non conductors as glass, porcelain, plaster, vulcanite, and cellulose acetate

One of the most remarkable exhibits consisted of very thin gold and nickel films, prepared by Dr Carl Muller of the Physikalisch Technisches Reichsanstalt, Charlottenburg, Berlin These gold films are 60 mm in diameter, and, although transparent, quite non porous The thickness of the films is no more than 0 00002 mm One of the applications of these films is for use as windows for cathode ray tubes, for which purpose they are supported on grids It is interest ing to add that Dr Müller has exhibited elsewhere similar electrolytic films, ranging from 0 00002 mm up to 0 001 mm in thickness, in both a polished and matt condition In one of these exhibits the trans parency of these films was illustrated in a striking way, printed type being distinctly read through six foils placed one behind the other The Royal Aircraft Establishment, Farnborough, at the same time exhibited films of aluminium oxide obtained in the anodic oxidation process which are of the order of one eighty thousandth of an inch in thick ness

Among the comprehensive exhibits of the Research Department of the Woolwich Arsenal, X ray spectra of deposited nickel were shown, indicating in striking fashion the difference between hard and soft nickel deposits The soft deposit is build up of nickel crystals, nearly all of which have their cube faces nearly parallel to the plane of the deposit, but have a random orientation about the direction of the current The hard deposit is built up mainly of a random arrangement of nickel crystals, but there is an appreciable number of crystals with their dodeca hedral planes parallel to the plane of the deposit, thus giving a weak symmetrical pattern in the perpendicular spectrum

Native Fish-Poisons as Insecticides.

THE use of certain orders of plants for purposes of stupefying and catching fish is almost world-wide, this practice in countries under British control is now deprecated and in many cases prohibited There are references to this custom scattered through-out the literature of exploration, and in the course of time a considerable list of the plants used has been compiled

Derris or tuba root (*Deguelia elliptica*) of the East Indies is the most widely known of these plants owing to its increasing use as an insecticide An examina tion at the Rothamsted Experimental Station of derris and many other tropical fish poisons, collected by Empire officers, indicated that for insecticidal purposes those of the order Leguminosæ were, in general, the most potent Among those of a high order of toxicity are two plants used by the Indians of British Guiana and known to them as white and black haiari (*Lonchocarpus* spp), which contain the characteristic principle of derris root—now known as rotenone—a most potent insecticide These plants, which are lianes, have been collected in the forests of British Guiana by Mr R A Altson, but such is their habit of growth that the definite species has not been so far recognised An attempt is now being made to cultivate the haiari plants for commercial use as insect sprays and animal dips, and the Empire Marketing Board has made a grant for an investigation at an agricultural experimental station in British Guiana In the meanwhile, it is hoped that the woods and forests of British Guiana will not be denuded of plants of such prospective value

Other Leguminosæ of interest, from the fact that they possess both fish poisoning and insecticidal properties, are yarraconalli (*Tephrosia toxicaria*) of British Guiana and iLozane (*Tephrosia macropoda*) from South Africa The fact, however, that *Cocculus Indicus* (*Menispermaceæ*) possesses the same dual properties would indicate that they are not entirely limited to leguminous plants The constitution of the active principles, which are neither alkaloids nor glucosides, is unknown, although much useful research on rotenone has been in progress for several years They are possibly closely related compounds, and should well repay investigation In addition, there is much to be done to clear up the confusion of the identification of the plants arising out of the use of native names The encouragement of the Empire Marketing Board may well lead to a wider use and more extended knowledge of these interesting plants

Sea Trout from the Moray Firth

THE Scottish sea trout is a creature of much more variable habit than the Scottish salmon Mr G Herbert Nall has shown that it is a plastic species capable of adapting itself readily to its environment and reflecting in a marked degree the feeding possi-bilities of the area which it inhabits (*Fisheries, Scotland, Salmon Fish*, 1929, No 111)

The south westerly area of the Moray Firth, com-prising the Inverness Firth and the Beauly Firth, is an extensive sheet of somewhat shallow water It forms a rich feeding ground for the sea trout of the Ness and Beauly and a few minor streams Many of the fish feed most actively and grow most rapidly in summer But in mid winter, shoals of sprats and small herrings enter the firths and a large portion of the trout feed heavily upon them, and in spite of lower temperature have a period of maximum growth and fatness between

November and February Moreover, the scales of certain fish reveal on examination strong evidence that individuals may be winter feeders one year and summer feeders the next Thus, the trout of the district seem to be in a transitional stage of partial adaptation to their special environment

Between January 1921 and January 1924, nearly sixteen hundred sea trout, brown trout, and parr were marked in the Beauly Firth and in the lower reaches of the Beauly and Ness Rivers in order to glean information regarding their migratory movements About 16 per cent of these have been recaptured, the recaptures proving that there is a constant movement and interchange of fish through the firth between the tidal reaches of the two rivers As only three marked fish have been recaptured outside the firths, there is little direct evidence that the Beauly Ness fish travel far from their rivers It is scarcely likely, however, that their movements are confined to this area, since from other districts there is abundant evidence that both finnock and adult trout undertake extensive coastal migrations, and that adult trout are caught at times far out at sea

Careful study of the scales of these sixteen hundred fish has also been carried out The reversal of the ordinary seasons of growth and rest render inadequate the usual methods of scale interpretation, and special methods had to be adopted to overcome this difficulty Like most sea coast trout, the Beauly Ness fish have short lives, and few survive to spawn more than two or three times One exceptional fish, however, was in its eleventh winter and had spawned seven times

University and Educational Intelligence

CAMBRIDGE —Dr A B Appleton, University lecturer in anatomy, has been elected to a fellowship at Downing College

Mr J C Dobbie, of Trinity College, has been appointed first junior observer at the Solar Physics Observatory

Dr H McCombie and Mr H Thirkill have been appointed members of the council of the School of Physical Sciences, and Dr E K Rideal and Prof Engledow members of the council of the School of Biological Sciences

EDINBURGH —On the recommendation of the University Athletics Committee, the University Court has appointed Colonel Ronald B Campbell as director under the scheme for the promotion of the physical welfare of students and the development of University athletics, the appointment to date as from May 1

LONDON —The following doctorates have been conferred D Sc in chemistry on Mr R P Linstead (Imperial College—Royal College of Science), for a thesis entitled "Three Carbon Tautomerism", D Sc in the history, methods, and principles of Science on Mr J H Woodger, University reader in biology, for a thesis entitled "Biological Principles", D Sc in zoology on Mr E A Spaul (Birkbeck College), for a thesis entitled "On the Activity of the Anterior Lobe Pituitary"

THE examinations for the award of scholarships in engineering, science, domestic science, and hygiene at the Battersea Polytechnic will be held on Wednesday, June 11, and succeeding days The scholarships vary in value from £20 to £30 per annum with free tuition, and are tenable for two or three years The latest day for applications is April 19 Full particulars may be obtained from the Principal

Two Theresa Seessel research fellowships for the promotion of original research in biological studies are being offered by Yale University The value of each is 1500 dollars Applications, accompanied by reprints of scientific publications, letters of recommendation, and a statement of the particular problem which the candidate expects to investigate, should be made to the Dean of the Graduate School New Haven, Conn, U S A, before Mar 1 next

THE Board of Education is again prepared to receive applications for full time studentships from teachers of five years' standing who desire financial assistance in order to attend approved full time courses of advanced study at universities or other institutions at home or abroad The amount of grant will not exceed £100 for an academic year The course proposed if academic, should be of at least post graduate type, but the Board is prepared to consider also proposals involving travel or the practical study of industrial conditions connected with the teaching of technical subjects Further information and application forms, to be returned by May 31, can be obtained from the Board of Education, Whitehall, London, S W 1

THE Cecil Peace Prize, of the value of £100, is offered yearly for an essay on some subject connected with the maintenance of international peace, and having some bearing on the principles or work of the League of Nations It is open to students of any university or university college in Great Britain or Northern Ireland who have not attained the age of twenty five years on the last day for submitting essays The subject for the year 1930 is 'Possible Developments of the Economic Activities of the League of Nations" The essay must be sent in to the Secretary, Universities Bureau of the British Empire, 50 Russell Square, London, W C 1, so as to arrive on or before Nov 1 next

FELLOWSHIPS and scholarships for advanced work in science and technology are listed in a bulletin (154 pages) recently published by the National Research Council of the National Academy of Sciences, Washington The number, variety, and value of these aids and encouragements are impressive A significant feature of the situation is the important part played by industrial firms and trade associations Eighty five such bodies support fellowships or scholarships Conspicuous among these is the E I du Pont de Nemours of Wilmington, which maintains 24 fellowships, each worth 750 1000 dollars, and four scholarships of 300 400 dollars The company selects each year the institutions in which the work is to be carried on The National Canners Association, on the other hand, which grants annually 19,000 dollars for research work in connexion with the wholesomeness and nutritive value of food, leaves the disposal of the grant entirely to the University of California, which uses it in large part for the payment of salaries of assistants and fellows who conduct the work under the direction of members of the faculty Among the methods employed by the Mellon Institute of Industrial Research, Pittsburgh, is a system of 'multiple fellowships', in which the services of one or more researchers are utilised under the direction of a senior fellow who, in turn, is responsible to the executive staff of the Institute These twenty one fellowships are financed from foundation sums covering all expenses of the specific researches for which they are given, including salaries, and ranging from 8000 dollars to 80,000 dollars While the activity of industrial firms in fostering research tends to the exaltation of applied science at the expense of pure science, the latter is of course not neglected in the allocation of funds in universities Under the head of astronomy, for example, twelve fellowships are mentioned, under mathematics, twenty six

Historic Natural Events.

Feb 9, 1913 Group of Meteors—A remarkable group of meteors was observed over Saskatchewan in Canada at 9 5 P M and was last seen from ships beyond Bermuda It travelled across Canada in seven minutes and probably struck the sea after a total path of 6000 miles, traversed at from 5 to 10 miles per second The whole group consisted of at least ten smaller groups, each containing 20 to 40 meteors, which kept perfect formation while the groups followed one after another along the same path, the whole taking more than three minutes to pass a given place The groups left long trails and were accompanied by a noise like distant thunder, and in some localities the earth vibrated, but only the leading meteor of the procession burst

Feb 10, 1236 Floods—Rain continued all through January, February, and a great part of March, and for eight days it rained almost without ceasing On Feb 10, immediately after the change of the moon, there was such a high tide in the Thames that boats might have been rowed up and down in Westminster Hall

Feb 11, 1895 Great Frost—The frost of 1895 lasted from Dec 30, 1894, to Mar 5, 1895, except for a week of mild weather on Jan 14–21 During almost the whole of this period easterly winds prevailed, which were especially strong in February The greatest intensity of cold occurred from Jan 26 to Feb 19, for which period the average temperature at Greenwich was below 26° F Minimum readings below 0° F were recorded somewhere in the British Isles every day from Jan 8 to 10 and 28, Feb 6 to 14 and 16 to 20, the coldest day being Feb 11 with -17° F at Braemar and -11° F at Buxton At Greenwich the lowest temperature was 7° F on the same day From Feb 9 to 17 the whole of the Thames was more or less blocked by ice, and it was impossible for full powered steamers to force their way up and down except with the tide Some of the ice floes were six or seven feet thick On Feb 18 the ice on the lake in Regent's Park was ten inches thick, in the Fens it was two feet, and at Oxford a coach and six were driven over the Cherwell Water mains were frozen at depths of three feet The frost was the most severe in Great Britain since that of 1813–14, but in Europe the winter, though severe, was not so rigorous as in 1879–80 7° F was recorded at Paris, and the Seine froze on Feb 10 There was heavy snow in France

Feb 12, 1493 Storm—On returning to Spain from his discovery of America, Columbus and his fleet were overtaken by a severe storm, which lasted three days and threatened them with destruction, so much so that Columbus wrote an account of his discoveries and threw it overboard

Feb 12, 1920 Snowstorm in Jerusalem—Twenty-nine inches of snow fell during the six days Feb 8–13 in Jerusalem This was the greatest fall of snow ever recorded there It began with heavy rain and sleet on Feb 8 and 9, a blizzard with wind of gale force blew on the Mount of Olives on Feb 9, but the snow did not lie until that night After that it snowed continually until Feb 12 The total depth of rain and melted snow was equivalent to 10 inches of water The minimum temperature recorded on the Mount of Olives during that time was 25° F Snow fell over a wide area and not only on the hills

Feb 12–14, 1899 Cold Wave—On the morning of Feb 11 pressure over northern Montana rose to 31 42 inches (1064 mb), and temperatures of -20° F were recorded so far south as central Kansas, the lowest being -61° F at Fort Logan, Montana During Feb 12 and 13 the 'high' passed southward over the Great Plains region to the Gulf of Mexico, and temperatures 8° and 13° F lower than previous records were registered at New Orleans and Mobile, Ala, respectively At Tallahassee, Fla, -2° was recorded Snow began to fall in the Ohio Valley on the morning of Feb. 11, and spread southward over the east Gulf and Atlantic States By 8 P M of Feb 13 the storm had become a raging blizzard centred over Cape Cod, with winds of 40 70 miles per hour Many people were frozen to death in the central and northern States, damage valued at millions of dollars was done to fruit orchards, game birds perished by the thousand, and poultry froze in their roosts Swiftly flowing streams froze over and fish were killed, even the Mississippi had one inch of ice at its mouth

Feb 13–14, 1892 Magnetic Storm—A violent magnetic storm accompanied by a magnificent display of the aurora which was visible, in spite of full moon, from Europe (so far south as Rome), Canada, and the United States above lat 36° Telegraphic systems in general suffered dislocation for a few hours The range in declination at Kew and Greenwich exceeded 2° and $1\frac{1}{4}$° respectively, the range at Washington was $1\frac{1}{4}$° At the time a very large sunspot, covering $\frac{1}{350}$ of the sun's visible hemisphere, was one day past the central meridian The region of the spot, which showed abnormal developments on Feb 11 and 12, was one of the first to be explored by Hale with his recently devised 'spectroheliograph' On Mar 11, that is, one solar rotation later as timed from the earth, another magnetic storm of somewhat lesser intensity took place, also accompanied by an aurora

Feb 13–14, 1923 Blizzard—The wind over the plains of North Dakota and Minnesota reached a velocity of more than 50 miles per hour with a temperature below freezing In spite of warnings by the Weather Bureau, more than twenty people froze to death and many cattle died, some of them suffocated beneath the snow The train services on branch lines were interrupted for more than a week, and on Feb 13 no trains ran even on main lines

Societies and Academies

LONDON

Royal Society, Jan 30—R N Salaman Crinkle 'A', an infectious disease of the potato Infection by grafting reproduces the disease in various varieties with certain modifications In one group the clinical picture is still that of crinkle, in another it is mosaic, and in a third, streak Infection by needle inoculation produces a reduced set of symptoms in all cases Crinkle 'A' is a complex of two or more viruses Infection of *Datura* gives characteristic reactions, but the leaves modify the virus, lessening the virulence Passage through tobacco does not increase its virulence —**R N Salaman and R H Le Pelley** Para-crinkle, a potato disease of the virus group Para crinkle is distinguished from crinkle 'A' by the fact that certain varieties highly susceptible to it are perfect carriers of para crinkle, while others, which suffer relatively mildly from crinkle 'A', are seriously affected by para crinkle Para crinkle is due to a single virus, its action can be completely destroyed by the products of metabolism of the leaves of *Datura* Its virulence is increased in those plants which are themselves raised from diseased tubers —**E C Smith and T Moran** The formation of lactic acid in desiccated amphibian muscles Formation of lactic acid in the

frozen state is due to the removal of water alone The peak in the production curve at $-2\cdot2°$ to $-2\cdot5°$ C (79 per cent water removal) is apparently coincident with the point at which death occurs instantaneously in the muscle No sudden change in concentration of any plasma constituent seems to be associated with these events —**H G Thornton** The influence of the host plant in inducing parasitism in lucerne and clover nodules When inoculated lucerne seedlings are placed in the dark, formation of fresh nodules soon ceases, and those already formed cease to grow This is associated with, and probably due to, cessation of cell division The bacteria become parasitic upon the host tissues In old nodules in lucerne and clover, growing in the light, bacteria behave similarly Lack of carbohydrate is the cause of change of behaviour of the bacteria, which then derive their energy from the host tissue —**F Kidd** and **C West** Physiology of fruit (1) Changes in the respiratory activity of apples during their senescence at different temperatures Carbon dioxide production by apple fruit rises for a period and then falls off continually, until the fruit dies as the result of invasion of the tissues by fungal organisms The accelera tion and deceleration of respiration rate have high temperature coefficients Change of respiratory activity is not due to changes in substrate concentra tion related to hydrolysis of sugars, starch, or cell wall materials, but to a change in state of the protoplasm

Geological Society, Jan 8 —Stanley Smith (1) Some Valentian corals from Shropshire and Montgomeryshire, with a note on a new stromatoporoid The Valentian coral fauna is not primitive, and is more closely allied to Salopian than to Caradocian assemblages, nevertheless, the important place occupied by the species of *Streptelasma* in the *Pentamerus* Beds links these up with the Ordovician The Purple Shales, on the other hand, have yielded several species of Rugose corals which are typically Salopian The Tabulate corals are of little interest, except in so far that they prove the very long range of the Lower Palæozoic species, there seems to be little, if any, difference between the Caradocian, the Valentian, and the Salopian forms —(2) The Carboniferous inliers at Codrington and Wick (Gloucestershire) The largest and most interesting is the Wick Rocks Inlier, on the same line of latitude as the Avon Gorge and some 9 miles to the west The several outcrops expose, although not quite completely, a succession of beds ranging from the Tournaisian (Z_2) to Coal Measures The arenaceous beds which succeed the limestone sequence are better exposed in the Wick Inlier than anywhere else in the Bristol district These belong in part to the Lower Carboniferous, in part to the Upper, and within the series (formerly mapped as 'Millstone Grit') a considerable break in the Carboniferous succession must occur The general succession of the Carboniferous in the area under discussion is given The gap between the Lower and the Upper Carboniferous is placed tentatively at the top of the massive grits which contain the 'Mollusca Band'

Linnean Society, Jan 9 —W H Thorpe Further notes on biological races in *Hyponomeuta padella* (Linn) It has been shown previously that the small ermine moth, *Hyponomeuta padella* (Linn) [*H variabilis* Zell, *H malinella* Zell] is split into two well marked biological races, one attached to apple, the other to hawthorn, blackthorn etc Further evidence suggests that the latter form is itself split into two less strongly marked biological races, one attached to blackthorn (*Prunus spinosa*) and the other to hawthorn (*Cratægus Oxyacantha*) —**J T Cunningham** The origin of adaptations Two recent general reviews of the subject of adaptation in animals entirely omit consideration of (1) metamorphosis and recapitulation, (2) sexual dimorphism, especially the relation of these phenomena to internal secretions or hormones Consideration of these subjects is essential to the discussion of animal adaptation The chief general conclusion is that evolutionary changes are of two kinds, namely, those which consist of mutations of internal origin, with no relation to external conditions, and those which have such a relation and can be ascribed to the action of external stimuli

EDINBURGH

Royal Society, Jan 13 —George Bond Occurrence of cell division in the endodermis Endodermal cells frequently show a considerable increase in tangential dimension at a comparatively late stage in their existence This increase in size is often accompanied by their division, the new walls being radially orientated in the main The divisions may actually cause the increase in size of the original cells, or they may follow passive stretching Two types of division are distinguishable (a) Those occurring in primary endodermal cells, (b) divisions in tertiary endodermal cells The second type is the more common, and as many as twenty five successive divisions of this type may occur in one original cell The condition of the endodermal cell at the time of stretching and division determines which type of division appears In neither case does the development of new walls interfere with the efficiency of the endodermis as a physiological barrier — **David G Catcheside** Chromosome linkage and syndesis in *Œnothera* Cytological studies were made upon pollen mother cells of two close pollinated, small flowered species of *Œnothera*, *Œ pycnocarpa* Atk & Bartl and *Œ nutans* Atk & Bartl A single, continuous spireme is formed, the whole diploid complement of fourteen chromosomes is arranged in a ring at diakinesis, the chromosomes being attached end to end A triploid plant of *Œ pycnocarpa* had the twenty one chromosomes arranged end to end in a closed circle The telosynaptic view of chromosome conjugation is supported for the genus the recent parasynaptic hypotheses being examined critically Darlington's theory, that ring formation in *Œnothera* is due to segmental interchange between non homologous chromosomes of the same complex, fails to account for the formation of a ring in the triploid form Support is given to Sheffield's theory that ring formation is an heritable phenomenon controlled by genes in the chromosomes —**D R R Burt** On a case of intersexuality in *Bos indicus*, with a theory of the significance of the genetic male intersex An abnormality is described in which there is a functional ovary on the right side associated with a complete Mullerian duct, and a cryptorchid but small testis on the left associated with a complete Wolffian duct The animal is a genetic male intersex A hypothesis is suggested which postulates the action of a maternal sex hormone in initiating and controlling sex reversal during intra uterine development, the difference between the left and right sides being attributed to earlier differentiation of the left gonad in cattle Actual confluence of the blood vessels of the crypts and villi during development may be responsible for the abnormality This hypothesis reduces the two classes, the free martin and the genetic male intersex, to the same order

PARIS

Academy of Sciences, Dec 30 —A Cotton Asymmetric synthesis and the existence of racemic compounds in solution Some remarks on a recent paper

by Werner Kuhn and E Braun It has been generally held that racemic compounds cannot exist in solution an experiment with a mixture of solutions of lævorotatory and dextrorotatory copper tartrates is described which is regarded as furnishing evidence of the contrary view —**Jean Perrin and Mlle. Choucroun** Fluorescence sensibilised in liquid medium (transfer of activation by molecular induction) —**Marcel Brillouin** The dynamical tides of an ocean comprised between two parallels Simultaneous normalisation —**Charles Nicolle, Charles Anderson, and Jacques Colas-Belcour** The rôle of *Ornithodorus erraticus* in the natural transmission of two recurrent spirochætes The danger of the propagation of recurrent Hispano-Moroccan fever in Algiers and Tunis —**A Gelfond** Transcendental numbers —**Mme M Piazzolla Beloch** The number of odd branches of curves belonging to a surface of the third order —**G Pfeiffer** The integrals of partial differential equations and of systems of equations of the first order of an unknown function, which possess S Lie integrals —**Marcel Brelot** The problem of Dirichlet external in the plane relatively to the equation $\Delta u = c(x, y)\ u$ —**Léonidas Kantorovitch** Projective ensembles of the second class —**J A Lappo-Danilevski** Analytical functions of a single variable substitution —**Oystein Ore** Hypergeometric functions of several variables —**Miloch Radoitchitch** Inverse functions of meromorph functions —**J Petrovsky** Functions primitive with respect to a continuous arbitrary function —**J Haag** The general theory of synchronisation —**Joseph Pérès** A formula for the calculation of the resistance of a solid in an incompressible perfect fluid —**Alex Véronnet** The theory of the formation of large ions and droplets —**L Décombe** Melde's experiment and the conditions of Sommerfeld —**Th Vautier** The dissipation of the energy transported by an aerial wave —**G Reboul** A method of activation of matter —**Michel** The calculation of a galvanometer —**Emmanuel Dubois** The Volta effect The influence of the oxidation of the electrodes For the various metals examined, the presence of oxygen, either adsorbed by the metal, or combined with it, makes the metal electronegative —**Trajan D Gheorghiu** The absorption of dextro- and lævorotatory copper tartrates and of their mixture The measurements were made with a photoelectric photometer The absorption of the two tartrates is the same, but the absorption shown by the mixture is clearly greater —**J Dufay and Mlle R Schwégler** The visual measurement of very small luminosities The object of the experiments was to determine the accuracy with which measurements of faint luminosities of less than 10^{-6} candles could be made —**H Volkringer** The band spectra of zinc vapour Zinc vapour, heated to a red heat in a silica tube, gives a band spectrum when excited by discharge without electrodes Measurements are given of lines between the wave lengths 2983 A and 3282 A From the large distances separating the lines it is concluded that the molecule has a very small moment of inertia The possibility of the spectra being due to zinc hydride is discussed —**René Audubert** The photolysis of water and the photovoltaic effect of electrodes of gold and platinum —**Mlle Marguerite Quintin** The influence of the medium on the photovoltaic effect of iodide of copper The results given show that the phenomenon depends upon the action of light both on the liquid and on the photosensitised substance —**Mlle Iréne Curie and Frédéric Joliot** The nature of the absorbable radiation which accompanies the α-rays of radium Strong preparations of polonium produce in air an heterogeneous H radiation (maximum path about 16 cm of air) and these probably result from a transmutation of nitrogen It is this radiation which was taken for a γ radiation of polonium in the experiments of Russell and Chadwick —**E Rinck** The equilibrium in the fused state between potassium, sodium, and their iodides In this reaction the law of mass action $(Na)(KI)/(K)(NaI) = c$ has been verified, the mean value of the constant c being 56 —**Néda Marinesco** Dielectric polarisation and structure of absorbent colloids —**J Séailles** A new method for the preparation of alumina in the wet way —**L Andrieux** The preparation and properties of the borides of tantalum and colombium The general method is the electrolysis of fused baths of mixtures of the oxide of tantalum (or columbium), magnesium (or calcium, lithium, sodium), borate and a fluoride The borides obtained proved on analysis to be TaB_2, CbB_2 They are very hard and easily scratch quartz —**E Carrière and Rouanet** The estimation of fluorine as calcium fluoride —**P Fleury and P Ambert** The precipitation of sugars and of polyols as a cupro baryta complex —**Raymond Charonnat and Raymond Delaby** The constitution of dioxypyramidon By total and partial alkaline hydrolysis the constitution of this substance is proved to be CH_3 CO $N(CH_3)N(C_6H_5)CO$ CO $N(CH_3)_2$ —**Georges Darzens and André Lévy** The primary phenyl dimethyl ethyl alcohol and some of its derivatives —**C Gaudefroy** Half wave and quarter wave achromatics by the superposition of several crystalline plates —**P L Mercanton** Observations made on board the *Pourquoi Pas?* with the pycnosonde of La Cour and Schou (summer 1929) Proofs of the value of this new instrument —**R Bureau** The daily variation of atmospherics monthly means, annual variation, meteorological influences —**J J Thomasset** The calcospherites of fossil tissues —**Mlle Germaine Py** Cytological researches on the nutritive layer of the pollen grains of *Helleborus fœtidus*, *Euphorbia Sauliana* and *E Peplus* —**B P C Hochreutiner** A new genus modifying slightly our conception of the family of the Malvaceæ —**N Wagner** The chondriome of the embryo in *Cucurbita Pepo* in the dry seed and during germination —**M Bridel and J Rabaté** The distribution of piceoside (Ch Tanret's piceine) in the vegetable kingdom Piceoside, the glucoside of *Picea excelsa*, salinigrine, glucoside from the bark of the black willow and ameliaroside, glucoside from *Amelanchier vulgaris*, are all the same substance, the β- glucoside of *p* hydroxy-acetophenone —**E Michel-Durand** The influence of treatment with alcohol on the extraction of tannin from plants A preliminary treatment of the acorns of *R robur* with boiling alcohol renders the tannins insoluble in acetone —**Aug Chevalier** *Striga hermonthica*, a Scrophularia parasite on cereals in tropical Africa —**A Demolon and G Barbier** The fixation and mobilisation of phosphorus pentoxide in muds —**Pierre Lesne** The distribution of *Glossina* in the region of the Zambeze de Chemba (Portugese Eastern Africa) —**C N Dawydoff** The presence of the genus *Ctenoplana* in the waters of French Indo China —**Jacques Colas-Belcour** The identity of *Ornithodorus erraticus* and *Ornithodorus marocanus* —**N K Koltzoff** The element of time in physico-chemical excitability —**Jean Régnier and Fernand Mercier** Dextrorotatory pseudococaine and lævorotatory cocaine, comparative trials of rachianæsthesia in the dog —**J Lemarchands** The proportions and the localisation of the carbohydrates in the seed of *Helianthus annuus* and their variations in the course of germination —**Léon Velluz** The action of soaps on the toxicity of certain alkaloids (cryptoalkaloids) The toxic action of strychnine and veratrine is reduced by solutions of soaps (sodium palmitate, sodium ricineolate) —**Ch Champy and M. Heitz-Boyer** The mechanism of the action of the high frequency electric cautery Study of the me-

chemical effects of high frequency currents their hæmostatic action on the vessels —**Léon Binet** and **Charles Mayer** A new technique of blood perfusion — **C Levaditi** and **F R Selbie** The mode of transmission of acute epidemic polymorphous erythema The mouse is subject to a spontaneous generalised infectious polyarthritis, caused by *Streptobacillus moniliformis*, the pathological agent of certain infectious polymorphous erythemas It appears to play an important part as the reservoir of the virus and agent of transmission of the disease

Official Publications Received

BRITISH

Royal Commission on National Museums and Galleries Final Report, Part 2 Conclusions and Recommendations relating to Individual Institutions, dated 1st January 1930 (Cmd 3463) Pp 104 (London H M Stationery Office) 2s. net.

The Journal of the Institution of Electrical Engineers. Edited by P F Rowell. Vol 68, No 397, January Pp 97 204+xxxviii (London E and F N Spon Ltd) 10s 6d

Amgueddfa Genedlaethol Cymru National Museum of Wales Twenty second Annual Report, 1928-29, presented by the Council to the Court of Governors on the 25th October 1929 Pp. 89+6 plates. (Cardiff)

Dove Marine Laboratory, Cullercoats, Northumberland Report for the Year ending June 30th, 1929 Edited by Prof Alexander Meek (New Series 18.) Pp. 52 (Newcastle on Tyne Armstrong College) 5s

Report on the Second Imperial Mycological Conference 1929 (Issued by the Colonial Office.) Pp. 42 (London H M Stationery Office) 1s 6d net.

Report of the Haffkine Institute for the Year 1928 By Major S S. Sokhey Pp 44 (Bombay Government Printing and Stationery Office) 2 annas, 3d

Memoirs of the Indian Meteorological Department Vol 25, Part 4 Correlation between Weather and Crops with Special Reference to Punjab Wheat By Rao Sahab Mukund V Unakar Pp 145 161+2 plates (Calcutta Government of India Central Publication Branch) 1 rupee, 1s. 9d

Proceedings of the Edinburgh Mathematical Society Series 2, Vol 2, Part 1, January Edited by Prof H W Turnbull and Dr W Saddler Pp 60 (Edinburgh)

Mathematical Notes a Review of Elementary Mathematics and Science Edited by William Arthur No 25, January Pp xx (Edinburgh Edinburgh Mathematical Society)

Report on Smoke Abatement Prepared by a Sub Committee of the Science Standing Committee of the Royal Institute of British Architects Pp 7 (London Royal Institute of British Architects.) 1s

FOREIGN

Anuario del Observatorio Astrónomico de Madrid para 1930 Pp 592 (Madrid Instituto Geográfico y Catastral)

Proceedings of the American Academy of Arts and Sciences Vol 64, No. 1 Alternating-Current Nets By Arthur E Kennelly Pp 18 45 cents. Vol 64 No 2 The Elastic Moduli of Five Alkali Halides. By P W Bridgman Pp. 19-38. 45 cents Vol 64, No. 3 The Effect of Pressure on the Rigidity of Several Metals By P W Bridgman Pp 39-49 45 cents. Vol. 64 No. 4 The Compressibility and Pressure Coefficient of Resistance of Several Elements and Single Crystals By P W Bridgman Pp 51 78 60 cents (Boston, Mass.)

Sitzungsberichte der physikalisch medizinischen Sozietät zu Erlangen Herausgegeben im Auftrag der Sozietät von Oskar Schulz Band 60, 1928 Pp. xix+389+4 Tafeln (Erlangen Max Mencke)

The Carnegie Foundation for the Advancement of Teaching Bulletin No 24 The Literature of American School and College Athletics By W Carson Ryan, Jr Pp xiv+305 (New York City) Free.

Proceedings of the Imperial Academy Vol. 5, No. 9, November 1929 Pp. xxi xxii+403 441 (Tokyo)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan Fourth Series (Biology) Vol. 4, No 4, December 1929 Pp 577-673+ plates 26-29 (Tokyo and Sendai Maruzen Co. Ltd)

Scientific Papers of the Institute of Physical and Chemical Research No 219 The Influence of Autoclave Treatment on the Form of Hydroxides and on the Nature of Colloidal Suspension By Tominosuke Katsurai Pp 161 166. (Tôkyô Iwanami Shoten) 15 sen

The Memoirs of the Imperial Marine Observatory, Kobe, Japan Vol 3 No 4 November 1929 Pp 167 186+6 plates (Kobe)

Palæontologia Sinica. Series D, Vol. 6, Fascicule 1 A Study of Kansu and Honan Aeneolithic Skulls and Specimens from Later Kansu Prehistoric Sites in comparison with North China and other recent Crania. Part 1 On Measurement and Identification By Prof Davidson Black Pp iii+83 (Peking Geological Survey of China, London Edward Goldston)

Meddelanden från Statens Meteorologisk Hydrografiska Anstalt. Band 5, No 3 Den Kemiska Denudationen i Sverige (La Dénudation chimique en Suède). Av J V Eriksson Pp. 96 (Stockholm.) 5 00 kr

Statens Meteorologisk Hydrografiska Anstalt. No. 276 Organisation Météorologique Internationale. Commission de Météorologie agricole Procès verbaux de la 3ème réunion, Copenhague, 1929 Pp. 101. (Stockholm) 2 50 kr

The Peking Society of Natural History Bulletin, Vol 4, Part 1 Society Proceedings and Membership List. Pp iii+115 (Peking) 1 dollar

Proceedings of the American Philosophical Society Vol. 68, No. 3 Pp. 163 274+2 plates. (Philadelphia.)

Annual Report of the Board of Regents of the Smithsonian Institution, showing the Operations, Expenditures and Condition of the Institution for the Year ending June 30, 1928 (Publication 2981) Pp xii+763+ 145 plates (Washington, D C Government Printing Office.) 2 dollars.

Department of Commerce U S Coast and Geodetic Survey Special Publication No 140 Manual of First-Order Levelling By Henry G Avers Pp iii+98+9 plates. (Washington, D C Government Printing Office) 30 cents.

Diary of Societies

FRIDAY, FEBRUARY 7

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10 30 A M —Prof Neumann, E M Atkinson and H W B Cairns Discussion on Brain Abscess

ROYAL SOCIETY OF ARTS (Indian Meeting) at 4 30 —G H Tipper Recent Mineral Developments in India

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Sir John Rose Bradford Massive Collapse of the Lung

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle upon Tyne) at 6 —S. S Cook High Pressure Steam for Marine Work

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Chamber of Commerce, Birmingham), at 6 30 —A. G Lobley Electric Furnaces for Heat Treatment

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Institute of Fuel) (at Engineers Club, Manchester), at 7 —Prof M W Travers The Fundamental Problems of Fine Gas Purification

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7 —G F Shotter A New Null Method of Testing Instrument Transformers and its Applications —R J S Spilsbury and Dr A. H M Arnold Some Accessory Apparatus for Precise Measurements of Alternating Current.—Dr A H M Arnold Precision Testing of Current Transformers

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group) at 7 —Practical Evening

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle upon Tyne), at 7 15 — W G Thompson The Electrical Propulsion of Ships

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Royal Metal Exchange Swansea), at 7 30 —W R Barclay Nickel Alloys in Modern Engineering

JUNIOR INSTITUTION OF ENGINEERS at 7 30.—G F O Riordan Co-operation between Technical Institutions and Industry

GEOLOGISTS ASSOCIATION (Annual General Meeting) (at University College), at 7 30 —Prof A Morley Davies The Geological Life Work of Sydney Savory Buckman (Presidential Address)

LEICESTER TEXTILE SOCIETY (at Victoria Hall, Leicester), at 7 30 — A Welch Celanese Yarns and Fabrics and their General Characteristics.

PHILOLOGICAL SOCIETY (at University College), at 8 —Prof V G Childe Philology and Archæology

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section) at 8 30 —C L Hewer and I W Magill Discussion on Anæsthesia in Thoracic Surgery

ROYAL INSTITUTION OF GREAT BRITAIN at 9 —Prof L Hill Diving

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB —Dr R. G Canti The Canti Cancer Film, showing the Effect of Radium on Cancer

SATURDAY FEBRUARY 8

MINING INSTITUTE OF SCOTLAND (at 79 Grassmarket, Edinburgh), at 3 — Sir Thomas H Holland Address —Discussion on J E Lambert's paper on Some Notes on Colliery Blasting Practice H A. Peach's paper on The Lochaber Water Power Scheme and its Geological Aspect.

ROYAL INSTITUTION OF GREAT BRITAIN at 3 —Rev G Cooke Tonality and Form

PHYSIOLOGICAL SOCIETY (at St Bartholomew's Hospital Medical College), at 3 30 —Demonstrations —Prof F L Hopwood Some Physiological Effects of Ultrasonic Sound Waves —Prof H Hartridge (a) Vacuum Reaction Velocity Apparatus (b) Reversion Eriometer —E M Landis and T Lewis A Case of Raynaud's Disease treated by Cervical Sympathectomy —A W Spence On the Effect of a Vitamin Deficient Diet on the Thyroid Gland of Rats —R Hilton (a) A Nose Piece for Administering Oxygen (b) A Simple Mouthpiece of Low Resistance for Collecting Expired Air during Dyspnœa —M Landis Micro-injection Method for Direct Determination of Blood Pressure in Single Capillaries of Human Skin —M O P Wiltshire Effect of Liver Tissue on the Rate of Destruction of Adrenaline —E A Carmichael and A Q Wells The Tissue Culture and Vital Staining of Microglia.—Prof H Hartridge and R. G R West Apparatus for Testing Electrical Reactions —At 4.45 — Cinema Films Demonstrated by A C Denny and J F Rogers.—Movements of Alimentary Tract in Experimental Animals by Drs. Carlson and Luckhardt —Drugs on Gastric Intestinal Motility, by Drs Kellogg and Dowd —At 5 30 —Communications —F Haynes Physiological Aspects of the Reaction of the Lungs to Inhaled Dusts —H G Reeves Dihydroxy acetone on Smooth Muscle —Prof H Hartridge and R G R West Chronaxie and Rheobase —Prof A V Hill The Change of Water Vapour Pressure caused by Substances added to Blood —F R Winton Tonus in Mammalian Plain Muscle.—M O P Wiltshire On the Rate of Oxidation of Adrenaline and the Assumed Sensitisation of Intestinal Muscle by Blood, Serum and Tissue Cells.—Mary Pickford and Dr E B Verney A Method of producing and studying the Effects of Acute Arrest of the Renal Circulation in the Unanæsthetised Dog.

MONDAY, FEBRUARY 10.

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Comparative Anatomy Lecture Room), at 4 30 —Prof J Barcroft Blood Storage —Dr J. Needham Nuclein Synthesis in Developing Eggs.—J T Saunders Water Movements in Lakes.—Dr A. Bishop The Culture of Trichomonas

BIOCHEMICAL SOCIETY (at Lister Institute), at 5 —R. Robison, M MacLeod, and A M Rosenheim Calcification *in vitro* —C R. Harington and W T Salter Enzymic Hydrolysis of the Thyroid Gland —P J G Mann and B Woolf The Action of Salts on Fumarase. I —V B Wigglesworth A Theory of Tracheal Respiration in Insects.—E Boyland Pyrophosphate in Yeast Preparations.—R. H Marriott The Action of Alkalis on Collagen —F Wokes Note on the Specificity of the Colour Tests for Vitamin A.

ROYAL SOCIETY OF MEDICINE (United Services Section), at 5 —Wing Comm H A Treadgold Cardiac Functional Efficiency in the Young Male Adult.

INSTITUTION OF AUTOMOBILE ENGINEERS (Joint meeting of Birmingham Centre and Graduates Branch) (at Queen's Hotel, Birmingham) at 7 —L H Dawtrey Automobile Brakes

INSTITUTION OF ELECTRICAL ENGINEERS (North Eastern Centre) (at Armstrong College Newcastle upon Tyne), at 7 —T W Ross and H G Bell Recent Developments in the Protection of Three phase Transmission Lines and Feeders

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members and Graduates Section) (at Borough Polytechnic), at 7 —B T Wingfield Automatic Control in Heating and Air Conditioning Installations

MANCHESTER ATHENÆUM TEXTILE SOCIETY (at Manchester), at 7 —W Wilkinson The Weaving of Fancy Cloths

INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent Glasgow), at 7 30 —S H Hawkins Pyrometry

MEDICAL SOCIETY OF LONDON, at 8 —Dr Maurice M Davies, and others Discussion on The Surgical Treatment of Pulmonary Tuberculosis

SURVEYORS INSTITUTION at 8 —J L Milne The Rating and Valuation (Apportionment) Act, 1928

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8 30 —Col F L Giles Boundary Work in the Balkans

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Cardiff).

ROYAL IRISH ACADEMY (Dublin)

TUESDAY, FEBRUARY 11

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Sir William Bragg X Ray Determination of the Structure of Cellulose and Similar Substances (1).

INSTITUTION OF CIVIL ENGINEERS, at 6 —R. W S Thompson The Diversion of the River Ashop

INSTITUTE OF MARINE ENGINEERS at 6 30 —C H Faris The Applications of Electro deposited Metals to Marine Engineering

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub Centre) (at Loughborough College), at 6 45 —G R J Parkinson Electrical Development.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole Leeds) at 7 —Dr J Hartmann The Jet Wave Rectifier The Experimental and Theoretical Basis of its Design

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN at 7 —Dr I C Martin Studies in Colour Vision

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at Royal Technical College, Glasgow), at 7 30 —W B Hird The Visit of the Institution to France

INSTITUTE OF METALS (North East Coast Local Section) (at Armstrong College, Newcastle upon Tyne) at 7 30 —W Richardson Electric Heating

QUEKETT MICROSCOPICAL CLUB (Annual Meeting) (at 11 Chandos Street W 1), at 7 30 —J Ramsbottom Presidential Address

EUGENICS SOCIETY (at Linnean Society) at 8 —E J Lidbetter and others Discussion on Poor Law

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (jointly with Leicester University College Biological Society) (at University College Leicester), at 8 —Prof R. H A Plimmer Proteins in Nutrition

ROYAL ANTHROPOLOGICAL INSTITUTE at 8 30 —Miss G Caton Thompson Recent Excavations at Zimbabwe and other Ruins in Southern Rhodesia

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN at 8 30 —Prof T G Hill The Biologic Factor in Plant Anatomy

WEDNESDAY, FEBRUARY 12

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Holborn Restaurant) at 2 30 —S Fox Half a Century of Boiler Making.

INSTITUTE OF METALS (Swansea Local Section) (at Thomas's Café Swansea), at 7 —Dr A G Ramsay The Corrosion of Non ferrous Metals.

SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (at Armstrong College, Newcastle upon Tyne), at 7 30 —Dr E G Ritchie Steam Storage in the Manufacturing Industries.

INSTITUTION OF ENGINEERS IN CHARGE (at St. Bride Institute), at 7 30 —H E Stilgoe The Water Supply of the Metropolis

HALIFAX TEXTILE SOCIETY (at White Swan Hotel, Halifax), at 7 30 —C R. Spedding Rags—their Origin and Uses

ROYAL SOCIETY OF ARTS, at 8.—H Jackson Colour Determination in the Fashion Trades

THURSDAY, FEBRUARY 13.

ROYAL SOCIETY, at 4 30.—Probable Papers —G Slater Studies on the Rhone Glacier, 1927 The Structure of the Ice in a Compressed Zone on the South Eastern Part of the Rhone Glacier —T Goodey On a Remarkable New Nematode *Tylenchinema oscinellae* gen. et sp. n parasitic in the Frit-fly, *Oscinella frit* L, attacking Oats.—D E Sladden Distortion of Development in Amphibia caused by Lack of Oxygen in very Early Stages in Development.—*To be read in title only* —Sir Frederick Keeble, M G Nelson, and R. Snow The Integration of Plant Behaviour Part II The Influence of the Shoot on the Growth of Roots in Seedlings —A W Greenwood and J S S Blyth The Results of Testicular Transplantation in Brown Leghorn Hens.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —T A. Joyce Architecture and the Industrial Arts of Pre-Spanish America (1).

INSTITUTION OF CIVIL ENGINEERS (Informal Meeting), at 6 —L. A. Legros The Influence of the Progress of Aeronautical Engineering on other Branches of Engineering Work.

INSTITUTION OF ELECTRICAL ENGINEERS at 6 —Dr J Hartmann The Jet Wave Rectifier The Experimental and Theoretical Basis of its Design

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6 30—J de la Cierva Recent Progress with the Autogiro

INSTITUTE OF MARINE ENGINEERS (Junior Section), at 6.30—S N Kent Discipline as applied to the Engine Room etc.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group—Informal Meeting), at 7

INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Section) (at University College, Dundee) at 7 30 —G H Chalmers Lubrication

INSTITUTE OF METALS (London Local Section) (at 83 Pall Mall), at 7 30 —H H Smith Temperature Measurement and Control in Works

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees side Branch) (Informal Meeting) (at Cleveland Institution Middlesbrough) at 7 30 —W T Butterwick and others Discussion on Are Government Regulations Effective in Preventing Marine Casualties?

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7 30 —F Twyman Optics in Radio Transmission and other Fresh Fields (Presidential Address).

FRIDAY, FEBRUARY 14

GENETICAL SOCIETY (at John Innes Horticultural Institution Merton), at 2 30 —Experiments on *Primula Sinensis* —Miss de Winton and J B S Haldane Demonstration of the Genetics of Diploid and Tetraploid Forms —Dr C D Darlington Exhibition of Cytological Preparations of the Tetraploid —Dr F W Sansome Exhibition of Slides Illustrating Pollen Behaviour in the Tetraploid —J B S Haldane The Genetics of the Tetraploid

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 4 —E W Hey Groves The Hunterian Oration

ROYAL ASTRONOMICAL SOCIETY (Annual General Meeting) at 5 —Presidents Address on the Award of the Gold Medal to Dr J S Plaskett for his Valuable Observations of Stellar Radial Velocities and the Important Conclusions derived from them

PHYSICAL SOCIETY (at Imperial College of Science) at 5 —W E Summerhays The Diffusion Constant of Water Vapour —M C Johnson A Method of Calculating the Numerical Equation of State for Helium below 6 Absolute and of Estimating the Relative Importance of Gas Degeneracy and Interatomic Forces —F D Smith The Magnetostriction Constant for Alternating Magnetic Fields —Demonstration by D Kempson of A Working Model illustrating the Mosaic Theory of the Compound Eye due to Altenburg

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society of London) at 6 —Annual Meeting

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting) at 7 —G S Taylor Lantern Lecture

OIL AND COLOUR CHEMISTS ASSOCIATION (Manchester Section) (at Milton Hall Manchester) at 7 —R G Daniels Common Sense and Nitro cellulose Lacquer

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at King's Head Hotel Coventry) at 7 30 —L H Pomeroy The Double six Engine

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting) at 7 30 —Technical Film—The Manufacture of Staybrite and Stainless Steels

INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University) at 7 30 —S Matthews Recent Developments in Measuring Instruments

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) at 8 —F Moore Unusual Coloration of Sclerotics —R Pickard The Red Field and Optic Disc Resistance in Glaucoma and Allied Conditions

ROYAL INSTITUTION OF GREAT BRITAIN at 9 —Prof A F Pollard History *à la Mode*

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Cardiff) —W G Davies Clinker and Ash Fusion

SATURDAY, FEBRUARY 15

ROYAL INSTITUTION OF GREAT BRITAIN at 3 —Rev G Cooke Tonality and Expression in Song Writing

PUBLIC LECTURES

FRIDAY, FEBRUARY 7

UNIVERSITY OF LEEDS at 8 —Prof Blanchard Human Geography and the Methods of teaching Geography

SATURDAY FEBRUARY 8

HORNIMAN MUSEUM (Forest Hill) at 3 30 —Miss M A Murray Ancient Egyptian Jewellery

MONDAY, FEBRUARY 10

UNIVERSITY OF LEEDS at 5 15 —Dr F A Bather Fossils and Fate

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7 —Prof J A S. Watson Recent Developments in the Feeding of Livestock

TUESDAY, FEBRUARY 11

KING'S COLLEGE, at 5 30 —C W Marshall Electrical Transmission by Overhead Lines (Succeeding Lectures on Feb 18 and 25)

WEDNESDAY, FEBRUARY 12

ROYAL ANTHROPOLOGICAL INSTITUTE (at Portland Hall Great Portland Street Extension of Regent Street Polytechnic) at 5 30 —H J C Peake The Beginning of Agriculture

UNIVERSITY COLLEGE, at 5 30 —A. F Ridley Librarianship as an Aid to Industry and Commerce.

BELFAST MUSEUM at 8.—Dr R H Hunter The Problem of Life

THURSDAY, FEBRUARY 13.

MEDICAL SOCIETY OF LONDON, at 5 15 —Prof B Blacklock Health in West Africa (Chadwick Lecture)

SATURDAY, FEBRUARY 15.

HORNIMAN MUSEUM (Forest Hill), at 3 30 —Dr C Ainsworth Mitchell Tell tale Inks

SATURDAY, FEBRUARY 15, 1930

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Editorial and Publishing Offices

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Unemployment and Hope

EVEN the most strictly scientific mind may, at the approach of spring, be allowed to wander somewhat out of the old and beaten track—indeed the scientific mind should be constantly on the search for new tracks—to indulge in flights of imagination and of hope, especially of hope It is the season of new hopes, new resolves, new thoughts, and though the hardened cynic may smile at their apparent futility, yet, however often we fall and fail, it is best to go on trying and keep the shining portals of hope, far distant though they be, still in view *Dum spiro, spero* So, in our title we have included hope, even in connexion with unemployment, and thus very flagrantly broken that excellent rule of the strictest school of economics which would rigidly exclude from consideration everything outside the indicative mood, and certainly everything appertaining to the optative mood (*vide* Prof Florence in his recent work on statistical method in economics)

In the following few notes and crude suggestions the point of view is taken that we should make the best of our present industrial civilisation, that that best is better than is often imagined, that perfect safety in the cosmic adventure, perfect ease, pleasure, and a generally 'soft time' for everybody, are unattainable, that danger and difficulty are always present and will increase in proportion as we advance, and that this progressive advance in the face of increasing danger and difficulty is the thing best calculated to develop a nation's highest qualities Nothing revolutionary is proposed, for a fairly thorough comparative study of economic systems past and present, including many so-called Utopias, has convinced us that nothing revolutionary can be proposed on any rational basis

Our present industrial society has many elements of strength and stability, and even of nobility, to which attention has been only slightly or not at all directed, and many elements of weakness on which attention has been unduly concentrated There is much that is sound and healthy, as is evidenced by the amazing fact that, despite the overwhelming ills with which it is supposed to be afflicted, society has continued as a going concern to this day in wonderful vigour, whereby millions are enabled to live a fairly healthy, active, and more or less happy life, and wherein hundreds of thousands find scope and opportunity—of which, to their unbounded credit, they fully avail themselves—for exercise of the highest virtues of integrity, skill, and courage These elements and

scope for their exercise can be increased almost indefinitely, and much that is evil will thus automatically be reduced or held in check; but not, perhaps, altogether exterminated, for the mysterious shadow of evil remains a sinister spectre in the background of all man's endeavour, leading him constantly into danger, and spurring him ever to greater efforts. It is well that it is so.

The aims of industry are, or should be, as indicated in a previous article, chiefly two: (1) to furnish a field for exercise of faculty and growth of character; and (2) to produce commodities to satisfy man's varied wants, mostly of a material kind, though of course there are large exceptions outside the material category, and the term 'material' is here used in no derogatory sense. Attention has hitherto been directed mainly to (2) and the primary aim of industry has been ignored. Such one-sided view of industry coupled with a too narrow use of the much abused word 'evolution'—as we shall see later—has led to over-concentration on quantity and mass production and a ridiculous neglect of the human element; and there can be no doubt that had a little thought been given to the first aim, then the second would have been much more completely and satisfactorily attained; also unemployment would not have been heard of, and, as pointed out, too, in the article referred to, the right use of leisure would have been treated rationally as a dominant factor.

Revolution being excluded, one has naturally turned to evolution as correctly expressing society's progress, assuming that progress in the right direction is being made; Ely's "Studies in the Evolution of Industrial Society" being a noteworthy contribution to the evolutionary view. But the use of the term evolution should not lead us to suppose that modern industry is evolving into some perfect and complete type or consummation. Existence would be very dull and dreadfully boring when such a state had been reached, with nothing left to hope and strive for. Then again, the best form or type of industry may not be and surely is not necessarily one particular fixed static type or form only, but may consist of many different and constantly changing forms, distinguished above all things by adaptability and elasticity—a living organism.

The prevailing idea, with exceptions here and there, appears to be that industry is evolving and must evolve towards one fixed type, for example, that of large scale production, with division of labour and specialism and consequent monotony of work pushed to still more disastrous extremes. But it is doubtful if this supposed ideal or consummation would work very long, or prove to be the best even from the merely material point of view of quantity production, and it would of course altogether ignore the spiritual aims of industry, namely, scope for development of faculty, character, and sound citizenship. This latter is a vital consideration, for the political strength of a nation is dependent on a spiritual or ethical view of industry.

What is to be more specifically understood as elasticity in the industrial structure is the provision of opportunity for other forms than that of large-scale production only, to develop and see what they can make of themselves. Beside large-scale production, or, more strictly, large-scale capitalistic production, there is co-operative production, which of course may be only another variety of large scale working but may also include much on the small scale. Large scale also may mean a conglomeration of several small and nearly independent units, such as an association of small dairy farmers, small village artisans or handicraft workers, and many such like. Elasticity further means the possibility of reviving, under new and improved forms to meet modern conditions, two at least of the older types of industry which are supposed to have been superseded or rendered obsolete by modern large scale production; namely, (1) small cottage industries or handicrafts, sometimes known as 'village industries' or 'home work' (in the factory inspector's reports) and sometimes as 'sweated industries'—as many of them are, though they need not, of course, be 'sweated', for this is an evil excrescence not essentially inherent; (2) a combination of manufacturing with agricultural or garden industry, including the possibility of providing the industrial classes with some form of land interest (see NATURE, Mar. 9, 1929, p. 341). If the evolutionary doctrine, as applied by Herbert Spencer and others to the social body, means that these and perhaps other and older forms of industry are useless anachronisms and may not contain something of vital value at the present day, then its application here has been profoundly erroneous and disastrous, stupid and short-sighted. Industry still has its roots firmly and deeply fixed in the past, and foolishly to tear up a great part of those roots as old and useless is the surest way to weaken the industrial tree. Perchance the source of the unemployment curse is to be found here.

The restitution of these two principles of an older industrial order, so essentially and characteristically English, under improved forms made possible by modern scientific achievement, including notably

electrical power distribution, would furnish, in the first place, a new and almost infinite field for human employment of all kinds, absorbing all or most of the present unemployed, giving extra occupation to those on short time, also scope for much organising talent and business ability now running to waste—a lot of it among the idle or leisured classes—through lack of opportunity. By unemployed we mean chiefly the unemployed in Great Britain only, but it would be vastly better to extend our consideration to cover unemployment throughout the whole world. For, first, this would provide a splendid additional bond for international co-operation and friendship, of which we cannot have too many; and, secondly, the solution or even partial amelioration of the unemployment problem in other countries would be bound to have advantageous repercussions on unemployment in Britain.

By accepting these two principles as a basis, with or without some kind of financial reform in the direction of a measurable amount of inflation, possibly on the lines suggested by Arthur Kitson, Douglas, and others, an approach can be made to the unemployment problem, as was done a few years ago rather successfully with the Greek refugees. The application of these two principles to unemployment is, of course, only one part of their scope, for they have a far wider range even than this, especially in counteracting one of the greatest evils of modern industry, namely, extreme specialism, monotonous work, and lack of scope for developing skill, with all that that implies.

Amid much controversy on unemployment, its causes and cures, one fact stands out in unmistakable clearness, and may safely be taken as a starting point. That is, the unemployed must have the wherewithal to live—food, raiment, shelter, and probably a few things above this wretched minimum. Can they be put in a position to supply most of these things for themselves? At present they lack a market for their labour, and yet they are themselves a huge potential market for labour and the products of labour. Another indubitable fact, standing clear above controversy even though it comes from the realm of economics, is that the instruments of production are land, labour, capital, and organisation or management. There is plenty of land available or reclaimable in Great Britain. Millions of pounds of capital could be provided by capitalising the 'dole' for five or ten years. The requisite organising and managerial ability is doubtless also in existence, but will have to be diligently sought out; much of it would probably be found or developed among the unemployed themselves, who also would supply the greater part of the labour.

The aim would be to establish a vast productive organisation, consisting in the main of village communities and garden cities, containing both large factories—if need be—and also cottage or home industries and handicrafts. A considerable amount of whole-time intensive farming probably on a large scale, together with market gardening and fruit growing, would be provided for; but a fundamental feature of the scheme would be a land interest for everybody, mostly a part-time interest wherein they could spend much of their leisure, and would include the possibility of owning homesteads containing up to quarter of an acre or more of land, part of which would be orchard. Training in some form of skilled handicraft would also be available to everybody.

These ideas could of course be applied to British industry generally, and not only to the organisation above mentioned, and thus some sort of antidote at least would be provided against two of the most serious evils of modern industrialism—complete alienation from the land and all that this means, on one hand, and entire lack of scope for exercising skill, on the other. A further evil, that of fluctuating employment, could also be met and means afforded for absorbing or 'damping out' a great part of these miserable fluctuations in labour demand; and something would have been done towards encouraging the right use of leisure, a vital matter in modern society, the implications of which are as yet too little appreciated. Science and research would play a dominating part, and large research institutes, especially in connexion with horticulture and growing under glass, would be established; also electrical or other forms of power would be utilised to the utmost, and though the term 'handicraft' may well be retained, it is fully intended that all the resources of modern science and engineering should be applied and every encouragement given to the further development of such resources.

It is probable that, under the more bracing atmosphere of varied work and interest and skill thus envisaged, the inventive faculties of mankind would be greatly stimulated, and a much needed spur be given to originality. It is doubtless difficult enough to generalise in regard to such an elusive thing as a nation's inventive talent or to trace the laws of its rise and fall; but it does seem to keen observers that, in view of the attention now devoted to education and research, the amount of originality and creative talent shown is a little

disappointing We refer not only to the mechanical or physical realm—perhaps it is fairly satisfactory here—but also to other departments of intellectual activity In the social sciences particularly, the lack of originality is deplorable, and outside empiricists are allowed to have their own way without let or hindrance or effective rejoinder

If there is any such decline in originality and inventiveness, the chief cause is probably extreme specialism In Adam Smith's time, division of labour may have been rightly included among the sources of invention to day, in its present extreme form, it is very likely a potent agent of torrefaction, and the springs of intellectual creativeness are dried up But never before in the history of the world has there been a greater or more urgent need for originality and freshness of view than now, and freshness of view includes seeing old ideas in a new light, old principles in new applications and environment

W G LINN CASS

The Structure of St Paul's Cathedral

St Paul's Cathedral By Arthur F E Poley With introduction by Sir Reginald Blomfield (Printed for the Author, "Willowbank", Hampton Hill, Middlesex) £7 7s net

THE author of this magnificent monograph to the genius of Sir Christopher Wren, as exemplified in the neo-classic masterpiece of St Paul's Cathedral, has produced with immense skill a work adequate for its subject Just and yet sensitive feeling, a perfection of refinement in draughtsmanship, and a devoted patience in execution, are distinctive throughout this work The standard set is high indeed and has reached the peak of accomplishment, it has been held there throughout, with an almost grim determination If there is a sense of effort in the monograph—a feeling as of a continuous striving—throughout this great record, which is not too apparent in the original work itself—that must be set down to the invariable difference between the soaring accomplishments of genius and those of the more mundane service of the historian, which last must pursue naturally a more pedestrian route, and follow the way of prose This, of course, will always be apparent unless the supreme artist enlightens us with his appraisement and knowledge, as reflecting on the work of another artist, for he alone could bring to the matter that unimpeachable intuition of the artist and the craftsman, native to the medium in which both work

The text of Mr Poley's monograph is also excellent, but its outstanding merit is the painstaking, amazingly patient, and skilful draughtsmanship reproducing with complete accuracy all the details of this supreme work of architecture

The volume contains matter historical and biographical, with building accounts and practical data, all entirely admirable in their way, but, perhaps wisely, no attempt has been made to examine into and explain the vast statical problem which faced Sir Christopher Wren in the technical resolution of his design

Wren was a fine mathematician, and it is perhaps fair to assume that coming comparatively late to the practice of architecture, he was not intimately acquainted with the practical science of the nature of materials and their behaviour under loading, or their interaction when erected into a structure in intimate association, all parts of the problem of architecture which call for the closest scrutiny into their maximum resistances under compressive and tensional stress

As a slight evidence of this supposition, witness Wren's surprising action in building into the eight great piers supporting the immense load of St Paul's dome (some 50,000 tons approximately), a core of rough mortared, uncoarsed and unbonded fragments of soft Caen stone, and indurated chalk, many fragments calcined by the fire of the old cathedral,* and all taken from the demolished building which preceded his own

It might well have been thought that Wren would have recognised that such a core would be unequal in bearing capacity to the external skins of his piers, faced with Portland stone This one factor in the problem of the preservation of St Paul's must have presented a serious difficulty to the highly expert committee dealing with the repair of the Cathedral, and must indeed remain a matter of anxious concern for all those in charge of the structure in the future

Again, Wren in his work at Hampton Court suffered odium from his enemies as a result of the fall of the east wall of the Palace consequent upon his building this wing across the recently filled section of the long canal at its west end

At St Paul's, Wren apparently built the foundations of his mighty church partly on soil compressed and loaded by the previously built cathedral, and partly upon unloaded and virgin soil, inevitably incurring a risk of relative settlements, as can indeed be found to have occurred in an examination of the structure to-day

Instances of this apparent lack of the strictly technical or merely practical knowledge of the use

of materials and the incidence of loading in building, can be multiplied, yet so profound and masterly was Wren's grasp of the main statical problems of his work, that these presumed defects in his science of construction—or shall we say this early lack of experience in building practice?—have not apparently imperilled as yet the great work which he did throughout the metropolis They must, however, cause serious heart searching on the part of those charged with the important responsibility of preserving all the work of his genius for posterity, unaltered and in their complete integrity

The authorities of St Paul's are, we believe, fully alive to their responsibility in this matter, and the wise assiduity with which Canon Alexander discovers and criticises any proposal which may be held likely to disturb the *status quo* or the conditions of solum, etc, surrounding the Cathedral, is evidence of this

The new architectural technique which has been slowly developed within the last half century, directed to the examination and understanding of the structural stability of old buildings, and the statical conditions which remain as a result of centuries of depreciation and change in the materials of which they were constructed, will, in the future, we feel sure, be capable of making accurate and yet conservative judgments as to how all the buildings and structures which we consider of vital importance as regards their preservation, can be retained for the future without prejudice to their architectural and historic amenity

It is a great advance in any event that structural work of preservation should be recognised as involving a different technique from that required by the erection of new structures, and Wren's great cathedral will, in the future, set many and intricate problems for resolution to those who are peculiarly qualified to deal with the changed stability factor in the buildings which survive the onrush of our modern civilisation Nothing, however, can dim Wren's genius He treated the renaissance with a freedom, audacity, and original sense of beauty which has never been surpassed, certainly in England His character contributed to his success, he was a man of deep and simple faith, witness his last words when very old, out of favour with the Court, fallen on evil days and evil tongues, in his little house which he had leased on the Green at Hampton Court He wrote "If I glory, it is in the singular mercy of God, who has enabled me to prosecute and finish my great work so conformable to the ancient and true model"

These words show his benign and serene spirit he had served the Crown and the public for fifty years, with supreme genius and confident activity, and saw the patent which he had received from Charles II withdrawn He was succeeded in office by an incompetent, who was unable to maintain the position for even a year, but Wren's work remains an outstanding possession for all time F B

Intensive Drying of Gases and Liquids

The Effects of Moisture on Chemical and Physical Changes By Dr J W Smith (Text Books on Physical Chemistry) Pp xii + 235 (London, New York and Toronto Longmans, Green and Co, Ltd, 1929) 15s net

THIS is a book which has long been needed It is a laborious compilation of all the work, until 1928, which has been done on intensive, or as it has been called by Longinescu, ultra drying A really satisfactory book it is not All the researches described are put on a level, there is no attempt made to deal critically with the different pieces of work The consequence is that in cases still under discussion, such as the dissociation of ammonium chloride, some researches which are obviously faulty are given the same weight as those which have been done with the greatest care Dr Smith has done one successful piece of work in this field, but he would probably be the first to acknowledge that he has neither the experience nor the knowledge which would enable him to deal faithfully with the work he describes Perhaps only half a dozen persons in the world could have done this adequately, and probably no one of them would have undertaken the labour of compilation so well done by Dr Smith

H B Dixon must be regarded as the founder of this branch of chemistry His discovery, just fifty years ago, of the inertness of a dried mixture of carbon monoxide and oxygen to an electric spark, was the *fons et origo* of all the true cases of intensive drying He was a pupil of A G Vernon Harcourt, perhaps the most careful worker in the history of chemistry, and a good deal of his care and attention to minute detail Dixon has been able to hand on to some of his own students It is noteworthy that only one substance is capable of acting as a true drying agent Phosphorus pentoxide owes its unique excellence in this respect to the fact that the product of its action on water is extremely stable Metaphosphoric acid can be distilled without decomposition at a bright red heat without giving up water Hence the water which phosphorus pentoxide absorbs, it retains It has, in addition, the

advantage of being, when pure, inert to a large number of chemical substances

For those who intend to work in this fascinating field, special training and a special attitude of mind are necessary It is not work for the slap-dash, get results quickly type of chemist It is hard to possess one's soul in patience when one reads papers, even in journals of good repute, which describe so-called repetition of older work In one series of papers on the boiling point of liquids, phosphorus pentoxide was introduced into an apparatus containing benzene, and the glass walls were given no chance of drying, since the desiccating agent was submerged in the liquid In another paper ammonium chloride (guaranteed by the makers as chemically pure !) was used, in spite of the fact that, as the authors admit, the salt turned yellow on heating In the work of which this is supposed to be a repetition, the ammonium chloride was boiled with nitric acid to destroy amines, sublimed and re crystallised eight times from the purest distilled water In the ideal book on the subject, such papers would either have been ignored or their errors pointed out, instead of allowing them to cloud the issue as Dr Smith has done

A good preliminary training for this class of work would be the determination of an atomic weight, since any error at once manifests itself by a discrepancy in the result It must be remembered, however, that the standard of purity of material and care in handling are very much higher than in atomic weight work, since the harmful quantities are imponderable Dust, often invisible, is probably at the root of many failures A practice has risen, in both the United States and Germany, of attempting to dry a glass surface by heating in an electric furnace while the apparatus is exhausted This method " which must produce at least as dry a surface as that attained by Baker " (*sic*) does not get rid of dust as does the standard method of heating the apparatus while a current of purified and dried air is passed through it It is necessary to burn up the invisible dust particles, for water is not the only effective catalyst It is also to be noted that in successful experiments the apparatus has been as simple as possible There should be, theoretically, no limit to the drying by phosphorus pentoxide at the ordinary temperature The maximum drying in a gas is said to be attained in two years (Bone) For liquids, as might be expected, the drying is much slower Judging by the boiling point of benzene, its rise in ten years was 38°, in seventeen years it is 56°, and even now the process is probably not complete

Dr Smith gives a good account of the various theories which have been advanced to account for the influence of extremely minute traces of water vapour Prof H E Armstrong, the *doyen* of British chemists, without whose encouragement one at least of the 'dry' chemists would have done little, was the first in the field with the theory of reversed electrolysis Others, ignoring the theory of probabilities, assume in ordinary actions a linking of water vapour with the reacting gases Smits, of Amsterdam, one of the most persevering and indefatigable workers, has published a theory based on his well known theory of allotropy Sir J J Thomson's theory, published in 1894, extended to include the precipitation of water vapour on ions, seems to me to explain all the facts, if one can conceive of a liquid drop of water persisting when surrounded by at least a million other molecules

With the limitations mentioned, the book may be recommended to students, but they would be wise, if, before beginning experimental work, they read a lecture by Sir Arthur Rucker, published in the *Journal of the Chemical Society* in 1888, and two papers on manipulation in the same journal for 1929

H B Baker

Reactions of the Nerve Cell to Injury

Degeneration and Regeneration of the Nervous System By Prof S Ramón y Cajal Translated and edited by Dr Raoul M May In 2 volumes Vol 1 Pp xx + 396 Vol 2 Pp viii + 397 769 (London Oxford University Press, 1928) 50s net

HIGH in the achievements of modern Spain must be ranked the development of a school of biological science which evolved from the work of the Madrid histologist, Prof Ramón y Cajal His perfections of the silver impregnation of nerve fibres so that their axis cylinder (or essential conducting element) could be revealed to microscopical observation, led to a long series of researches on the structure of the nervous system from about 1890 to the present time

Prominent in these researches are those devoted to the study of degenerative and regenerative processes in the nervous system, and while many of the main conclusions and methods had become known outside Spain, yet the multitudinous detail, the wealth of experiment and deduction, remained, at any rate to most English-speaking histologists, unknown There were several reasons for this, of which the more apparent are their publication in Spanish in journals enjoying small circulation,

and the publication of a limited number of copies of a work on the subject in Spanish, close before the outbreak of the War. The two volumes under review are the first English translation of this work.

The controversies over the polygenist and monogenist doctrines which took place in the first decade of this century have now only an historical interest. Nevertheless, the accumulated evidence collected in the first volume of this work not only provides a lasting memorial to the virile championship and establishment of the monogenist doctrine, but also is invaluable for all future work bearing on this subject. With a wealth of detail of fine critical microscopy, Prof. Cajal traced the replacement of damaged nerve fibre separated from its cell of origin. The detail of the process is so complex, the vagrancies of the wandering amœboid growing terminal so varied and multiple, that their unfolding and rationalisation by systematic experiment, clear cut and boldly planned, is a fascinating study.

The work of Ross Harrison in America still remains the crucial demonstration of the independence of the axis cylinder process, but the essential symbiosis of these two elements in their biological partnership depends for its illustration and proof on the findings of Cajal. Of the various hypotheses put forward to explain the re-establishment of conducting paths by regeneration, he comes now to favour a combination of the established attraction of the proliferated cell of Schwann, and the attraction of the end organ itself, to explain on one hand the obvious attraction that degenerated nerve has for regenerating processes, and on the other the occurrence of regeneration when no degenerated segment delineates the path of growth. These studies of the growing point of nerve fibres and its reactions appear to offer insuperable obstacles to any other explanation.

The second volume, dealing with the reaction of the nerve centre to injury, is, like the first volume, but even to a greater extent, a mine of information for all engaged on the physiology and pathology of the nervous system. It is only necessary, for example, to indicate the bearing of the complexity of collateral formation in neurones under "regenerative turgescence", on recent work by authors who, unmindful of these complexities of the subject, have adduced experiments on the dorsal nerve roots in support of efferent fibres (parasympathetic) in these roots. This exposition of the work of Prof. Ramón y Cajal and his school on the dorsal-root ganglion cells throws considerable doubt on the widely accepted physiological hypotheses built round the pericellular plexuses of these cells described by Dogiel.

Outstanding features of the second volume are the description of the phenomena of degeneration in the cerebral and cerebellar cortex following interruption of the axis cylinder processes. The hypertrophy of collaterals and the atrophy of the damaged axon are of great significance both physiologically and pathologically. Cajal reaffirms his belief in the lack of regeneration in the central nervous system, although he adduces the experiments of Tello to show this lack is not in the neurone, but in the absence of Schwann's cell.

At the end of most of the chapters an additional note has been added summarising work which has appeared since the publication of the Spanish edition. These notes in most part fulfil their purpose, but one could wish that the chapter on neuroglia and its reactions had included the recent work of del Hortega, and that on the cerebellum, the work of Cajal himself on the newer silver methods for studying this cortex.

The book is admirably produced and includes a very large number of excellent illustrations portraying the wonderful contrasted effects which only the reduced silver method can produce. The translation is perhaps in some few places too literal to read comfortably, but is always intelligible. In three places "afferent" is used where "efferent" is evidently intended (p. 269, l. 3, p. 271, l. 7, p. 272, l. 7), and "sensory" is obviously intended for "motor" on p. 272, l. 29, and the reviewer would also suggest that Nissl "granules" is more common usage in English that Nissl "grumes".

D. D. B.

Our Bookshelf

Allen's Commercial Organic Analysis: a Treatise on the Properties, Modes of Analysis, and Proximate Analytical Examination of the Various Organic Chemicals and Products Employed in the Arts, Manufactures, Medicine, etc., with Concise Methods for the Detection and Estimation of their Impurities, Adulterations, and Products of Decomposition. Vol. 7: *The Vegetable Alkaloids.* By the Editor, and the following Contributors: F. H. Carr, Oliver Chick, Norman Evers, J. J. Fox, T. A. Henry, P. J. Sageman, T. M. Sharpe, F. O. Taylor, R. W. Tonkin, and R. Whymper. Editor: C. Ainsworth Mitchell. Fifth Edition, Revised and Partly Rewritten. Pp. xi + 869. (London: J. and A. Churchill, 1929.) 30s.

THE editor of this volume can rightly claim that it is a complete thesis on the analysis of the vegetable alkaloids. It shows improvement over the previous edition for reference purposes, as all the material

on this important section of organic chemistry is now collected and classified in one book, which includes the subject matter from Vol 6 of the last edition on alkaloids generally, and on the volatile bases of vegetable origin, as well as the subject matter from Vol 7 on the vegetable alkaloids Special sections, arranged alphabetically, owing to the difficulty of chemical classification, are given to products of definite commercial importance in connexion with food and drugs (for example, caffeine, cocaine, nicotine, opium, etc , receive separate treatment) The other known alkaloids are systematically dealt with in a general introduction, again with alphabetical grouping In the introduction the reactions and properties of the vegetable alkaloids as a group are also reviewed

In contrast with the ordinary text-book, the drafting of a comprehensive technical thesis of this nature, with its great mass of specialised information, requires the assistance of many experts to make the venture a success As a result, we find each section written by a specialist in that particular field The whole work is ably edited by Mr C A Mitchell, who also contributes the chapter on strychnos alkaloids

There is lack of complete uniformity in the revision of material from the various editions of the British and foreign pharmacopœias, in some instances the latest data are not given, and there is want of agreement between the statements recorded A number of typographical errors have also been noted, and in a few instances information that would be expected in such a volume has not been found These slips and omissions, however, are probably not more than might be expected in a work of this nature The book, which is printed in the United States, is excellently produced with regard to paper, type, and binding J Reilly

The British Journal Photographic Almanac and Photographer's Daily Companion, with which is incorporated The Year Book of Photography and Amateurs' Guide and The Photographic Annual, 1930 Edited by George E Brown Pp 784 + 64 plates (London Henry Greenwood and Co , Ltd , 1930) 2s net

This welcome annual (for it is in no sense an almanac) again makes its appearance The general arrangement is very much the same as heretofore As this is the twenty fifth year in which the present editor has had the arranging of it, the article which he contributes consists of his personal reminiscences (or some of them), which will be read with much interest But we think that he has overstepped the mark to the detriment of the memory of Sir William Abney in stating that his various text-books display a pronounced disinclination to deal with the work of other investigators, and that therefore we have in English no comprehensive work similar to those of Eder in Germany and Fabre in France Abney never attempted such a comprehensive work, although the editor states that "he was the one man to supervise" it, and perhaps the editor himself gives the reason when he says that "it was an obvious effort to him to present a subject in simple terms" If Great Britain "suffered from the Abney predominance", as stated here, that surely was the fault of his contemporaries, as this is a free country

The volume includes the many items that we are accustomed to find in it, tables, formulæ, lists of addresses, new apparatus, and so on, and excellently reproduced gravure copies of photographs

Essentials of General Physiology By Prof Eric Ponder Pp viii + 497 (New York, London and Toronto Longmans, Green and Co , Ltd , 1929) 15s net

This is a sound and clearly written text book which should prove useful to students beginning physiology The opening chapters, of an introductory character, are advisedly concerned with a plain description of surface phenomena, colloids, permeability, dissociation, and the action of enzymes, the student may already be conversant with these aspects of physical chemistry, but his interest will be maintained by the well chosen biological examples Equipped with these elements of physical chemistry, the reader is better able to appreciate the actual physical and chemical basis of the processes underlying vital phenomena

The contraction of muscle, conduction in nerve, secretion, tropisms, digestion, respiration, and circulation are the branches selected by the author for treatment from the physico chemical point of view With the rapid and many sided development of physiology, the subject is becoming so unwieldy that, if it is to be approached from a scientific point of view, there will have to be a complete inversion of the present order of study, this book constitutes a step in the right direction, since a grasp of the underlying general principles should precede a descriptive study of the phenomena of the usual human and mammalian physiology As the book is intended mainly for beginners, perhaps more illustrations might be of value, this, however, is not a serious deficiency since the text is so lucid

Les paysages catalans leurs aspects, leur structure et leur évolution Par Marcel Chevalier (Aspects physiographiques de l'Espagne) Pp vi + 172 + 48 planches (Paris Albert Blanchard, 1929) 30 francs

There is comparatively little material available on the details of the geography of the Iberian peninsula This study of the north eastern corner of Spain is therefore welcome, although the author has dealt with little outside the purely physical aspects Apart from the comparatively recent plains, M Chevalier recognises three structural divisions in the mountains of Catalonia The Pyrenees in the north with their exposures of ancient crystalline and palæozoic rocks, then the sierras of secondary and tertiary rocks of a newer topography with no evidence of glacial action, and then, lastly, the worn-down remnants of old Hercynian foldings Structure and surface features are fully discussed There are many illustrations and sketch maps The book is an enlarged edition of a volume in Catalan that appeared recently

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

Hydrogen-like Spectra of Lithium and Beryllium in the Extreme Ultra-violet

IN preceding communications (NATURE, Nov 2, 1929, and *Comptes rendus*, Jan 1930) we have given a brief account of the extension of the extreme ultra violet down to 100 resp 88 A in the spectrum of doubly ionised beryllium (Be III) Using a vacuum spark with a considerably increased capacity and ionisation power, it has now been possible to record the strongest radiations in the hydrogen like spectra of completely ionised lithium (Li III) and beryllium (Be IV), thus extending optical spectra to 76 A

According to the Bohr theory, a system consisting of a nucleus with the positive charge e Z and a single electron will emit radiations with the following wave numbers (neglecting the slight correction for relativity)

$$\nu = Z^2 R\left(\frac{1}{n^2} - \frac{1}{m^2}\right) \text{ cm}^{-1},$$

the Rydberg constant R being slightly dependent on the mass M of the nucleus Thus,

$$R_M = R_\infty \frac{M}{m+M}, \text{ where } m = \text{the mass of the electron}$$

Using Paschen's value for the Rydberg constant (Paschen Götze, 'Seriengesetze der Linien spektren", Berlin, 1922) we obtain

$M_H = 1\ 008$	$R_H = 109\ 677\ 7$ cm $^{-1}$
$M_{He} = 4\ 0$	$R_{He} = 109\ 722\ 1$,,
$M_{Li} = 6\ 9$	$R_{Li} = 109\ 728\ 6$,,
$M_{Be} = 9\ 1$	$R_{Be} = 109\ 730\ 6$,,
	$R_\infty = 109\ 737\ 1$,,

The above relation gives for the spectrum of hydrogen the Paschen Ritz series for $n = 3$, the Balmer series for $n = 2$, and the Lyman series for $n = 1$ The calculated wave lengths of the first lines in the Lyman series are shown below Several lines of this series have been found by Lyman, Hopfield, and others

In the corresponding series of singly ionised helium (He II) Lyman found the first two members (*Astrophys Jour*, 60, p 1, 1924)

HYDROGEN

		λ calc
$n = 1$, $m = 2$		1215 68
	3	1025 73
	4	972 55
	∞	911 76

HELIUM

		λ calc	λ obs	Int
$n = 1$	$m = 2$	303 80	303 6	2
	3	256 33	256 3	1
	4	243 04		
	∞	227 85		

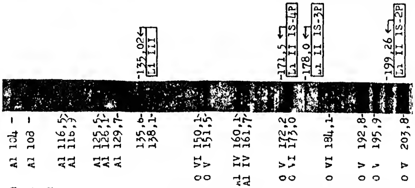

FIG 1 —Vacuum spark spectrum (enlarged 4 times) from aluminium electrodes tipped with LiOH Time of exposure 30 min

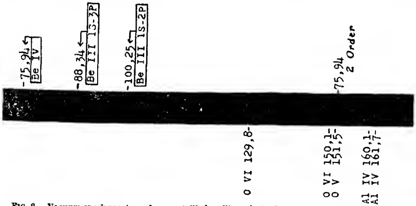

FIG 2 —Vacuum spark spectrum from metallic beryllium electrodes Time of exposure, 25 min

In doubly ionised lithium (Li III), which was hitherto not observed, we have measured the first two lines, the stronger of which was also obtained in the second order (Fig 1)

Trebly ionised beryllium (Be IV) is revealed by the first member of the same series, which has been measured as well both in the first and second order (Fig 2)

LITHIUM.

		λ calc	λ obs	Int
$n = 1$, $m = 2$		135 01	135 02	2
	3	113 92	113 93	0
	4	108 01		
	∞	101 26		

BERYLLIUM

		λ calc	λ obs	Int
$n = 1$	$m = 2$	75 94	75 94	1
	3	64 08		
	4	60 75		
	∞	56 96		

A detailed description of the apparatus and methods used in these experiments will appear in the *Zeitschrift für Physik*

BENGT EDLÉN
ALGOT ERICSON

Physics Laboratory, University,
Uppsala, Dec 19

Book Prices and Reading

"THE first of those 'little books on great subjects' is considerably shorter than the other two and costs five times as much [2s 6d] it cannot be regarded as over priced, it is rather the others that are extra ordinarily cheap" One of the others is a Benn 6d, "Earthquakes and Volcanoes", by Prof Gregory I think of the story told long ago of Lant Carpenter lecturing at the 'Vic' When gas came off but slowly, as 'water' was electrolysed upon the screen, a galleryite was heard to remark to his dissatisfied companion "Well, Bill, you can't 'spect to 'av many bubbles for a a'penny" What can't you now get for 6d from either Benn or Woolworth?

I have quoted from "Our Bookshelf", in NATURE of Jan 4 On previous pages I see books are noticed priced at 18s, 21s and 14s How can students afford to buy at such prices? They simply do not and do not read, they only use cram books As a consequence, Principal Tizard complains that young 'researchers' are uncultured, having read nothing, they also cannot write There seems to be a conspiracy of publishers to repress authorship A couple of years ago, a book of mine appeared of which I can say—adopting the Shavian principle that self praise is the only recommendation—that it was dear at 8s but at 7s 6d, the price at which the publisher led me to believe that it would be issued, it was as well worth a student having as any Shavian romance up to 10s, if only for the dedication, it was issued at 15s and killed Is it worth the publishers' while to kill at 15s when they might maintain in healthy activity at half the price? Prof Bone's Vol 3 on "Combustion" costs two guineas How can we poor chemists study our future fate at such price?

What is going to be the effect upon the writing and upon the sale of real books, upon reading, of Benn's pemmican—or shall we say, 'Bennican'? Mayhap the jam is spread too thickly upon the bread Or will it be, that, soon, the volumes will be issued with an insurance ticket—against more open reading?

To day you do not get any discount on your shilling Scientific journals, especially German, are sold at prohibitive prices Reading is not merely a disappearing art but becoming impossible no one can read in a library, the more as you must not mark the margins, let alone follow Darwin's good example and tear out the few pages that are of worth In addition, wireless is fast making headway as a reading soft option I know of two very distinguished men who formerly read omnivorously o' evenings now they just 'listen in' My daughter writes, that, on the Pacific coast, the theatre is deserted, because the effort of listening and attending to the play is too much for the boys—'the pictures' have reduced them to mental somnolency Why was not the recent London Opera Festival properly supported by the public? The performances were more than interesting Was not the price too high? Art lovers are as poor as are artists Is science, as wireless, in the hands of a few, to kill the intelligence of the many?

Into whose pocket is the book money going? Sir Ernest Benn is a great exponent of economics—has he at all fully studied the intimate economics of the bookshelf? The policy of failing to encourage good books, other than those written by popular favourites or shockers? He might well call, say, Marie Stopes, Mr Wells, the author of "All Quiet", into conference It would be interesting to hear from him what his Woolworth series is doing It is a fine effort

Truth is being withheld from the public—we only play with it Take biblical criticism Is it not *our duty* to present its results dispassionately, in clear readable form, even to the young? We seem now to be agreed that the mysteries of sex shall be displayed to the adolescent We are still afraid openly to discuss the foundations of the faith that is forced upon so many

Chemistry is in dire need of critical discussion we have not a single work that is broadly critical A recent Americanistic attempt is not encouraging The astronomers seem to be sailing close to the wind—when the fifth and other dimensions come along anything may happen we may then have what my Sunday paper calls 'gaudy incarnations of common vanity, day dreams *ad lib*' figuring as science

Our present treatment of books threatens to be a very serious hindrance to the development of habits of sound scientific thought, indeed of scientific progress Naughty ones seem to sell, whatever the price, nice ones do not Are we all to be forced to be naughty, only nice in a dim background?

HENRY E ARMSTRONG

Flint Implements of Upper Palæolithic Types from Glacial Deposits in Norfolk and Yorkshire

MY researches in East Anglia have demonstrated that palæolithic flint implements occur in the glacial Boulder Clays of this region, and that these deposits, and their contained artefacts, are of widely differing ages Thus, in the Tills overlying the Cromer Forest Bed of Norfolk, have been discovered specimens of Chellean type,[1] while, in what I term the Upper Chalky Boulder Clay of Suffolk, which appears to be separated from the Cromer Tills by a series of sands, gravels, and brick earths, I have found specimens referable to Late Acheulean and to Early Mousterian times[2] Upon the surface of the Upper Chalky Boulder Clay in the Ipswich district are situated, at certain places, two superposed and ancient occupation levels yielding implements of Upper Mousterian and of Aurignacian types, and these floors are covered by a considerable thickness of hill wash which, some years ago, I correlated with the latest glacial conditions obtaining in Suffolk[3]

Recently, during a research carried out under a grant from the Percy Sladen Memorial Fund, I have discovered, *in situ*, in the Brown Boulder Clay, and associated glacial deposits of the Hunstanton district in north west Norfolk, a number of flint implements of Upper Palæolithic types These specimens, which comprise blade scrapers, *burins*, or graving tools, cores, and flakes of various sizes, are to be referred to either the Aurignacian or to the Magdalenian epoch The artefacts lie at varying depths in the deposit, which is often rich in erratic rocks, and a number of them exhibit definite striations The Brown Boulder Clay is fully described in the Geological Survey memoirs[4] dealing with the area examined, and the sections from which I have recovered my specimens are classed by the surveyors as of glacial origin It is, however, necessary to point out that, while in the memoirs mentioned, the possibility, from a geological point of view, of the Brown Boulder Clay being of later date than the chalky variety of the district is suggested, no decision upon this important matter was reached by those who conducted the survey in north west Norfolk My researches, nevertheless, lead me to believe that the

Brown Boulder Clay, judging from the artefacts it contains, is clearly later than the chalky form

Further, the discoveries in north west Norfolk (which are to be described before the Society of Antiquaries on April 3 next) support, very strongly, the conclusions I had come to regarding the glacial origin of the hill wash overlying the floors, above mentioned, in the Ipswich district

Following upon the initial stages of my work in Norfolk, Mr J P T Burchell has carried out researches in Yorkshire, which confirm, in a striking manner, the archæological results obtained by me farther south, and it now seems possible to form an accurate and complete picture of the relationship of the various palæolithic industries to the glacial deposits of England

J REID MOIR

FOLLOWING upon Mr Reid Moir's notification to me that he had discovered flint implements of Upper Palæolithic types, at the base of, and scattered throughout, the uppermost Boulder Clay of north west Norfolk in the neighbourhood of Hunstanton, I determined to conduct similar investigations in a locality situated considerably farther northward The area I chose for examination comprised the intensely glaciated districts of Holderness and Flamborough Head in Yorkshire Detailed descriptions of the glacial deposits of these two localities occur both in Geological Survey Memoirs[5] and papers and books by Carvill Lewis, Dakyns, Lamplugh, Kendall, and others[6]

The researches, which I carried out under a grant from the Percy Sladen Memorial Fund and the Society of Antiquaries, resulted in the discovery, *in situ*, of a considerable number of flint implements of Upper Palæolithic types at the base of the uppermost Boulder Clay of the area This deposit contains an abundance of erratics, largely consisting of North British and Scottish rocks Similar implements I found scattered freely throughout this Boulder Clay, many of which show marked striations This industry, which consists, for the most part, of flake implements struck from tortoise cores, I would refer to Upper Mousterian Aurignacian times The specimens comprise hand axes, scrapers, gravers, blades, knives, and tortoise cores both struck and unstruck This discovery, which indicates a complete deglaciation of Holderness and Flamborough Head during the Pleistocene period, is of particular interest in view of Prof J K Charlesworth's paper of September last,[7] in which it is postulated that the terminal moraine which builds a gravel ridge on Flamborough Head and is traceable through Holderness to its south easternmost portion (the Cromer ridge) is Magdalenian in date That the moraine in question is earlier than the St Acheul period can be proved both on archæological and geological grounds

J P T BURCHELL

[1] *Antiquaries Journal*, vol 01 No 2 pp 135 137, April 1923
[2] *Jour Roy Anthr Inst*, vol 50 pp 135 152, January June 1920
[3] *Jour Roy Anthr Inst*, vol 47, pp 367 412, 1927
[4] The Geology of the Borders of the Wash " "The Geology of the Country around Fakenham Wells and Holt '
[5] The Geology of Holderness "The Geology of Bridlington Bay '
[6] Glacial Geology of Gt Britain, Carvill Lewis *Proc Geol Soc Yorkshire* n s, vols 7 and 8 *Quart Jour Geol Soc*, vol 47 pp 384 431, 1891 "The Geology of Yorkshire ', Kendall and Wroot, 1924
[7] *Quart Jour Geol Soc*, vol 85, pp 335, 359, 1929

On the Correct Formulation of Pauli's Exclusion Principle

PAULI'S 'Exclusion Principle' applied to the simplest case of the two electron or two proton system (helium atom, hydrogen molecule) is usually stated as follows if the electrons (or protons) are parallel, that is, if their spins point in the same direction, their eigenfunction must be antisymmetrical with respect to the co ordinates, if the electrons (or protons) are antiparallel, that is, pointing in opposite directions, their eigenfunction must be symmetrical

I wish to point out that this formulation of Pauli's principle is erroneous There is actually no direct relation between the symmetry character of the eigenfunctions (as functions of the co ordinates alone) and the orientations of the electrons (or protons) In every stationary state of a single electron with a given energy E, *both* orientations are in general possible, although they have different probabilities (in the same way as the different values of the co ordinates) In Pauli's theory of the spinning electron (*Zs f Phys*, **43**, p 601, 1927) these probabilities can be defined by means of two eigenfunctions $\psi_\alpha(x, y, z)$ and $\psi_\beta(x, y, z)$ which are the solutions of a system of two simultaneous differential equations

$$H_{\alpha\alpha}\psi_\alpha + H_{\alpha\beta}\psi_\beta = E\psi_\alpha, \quad H_{\beta\alpha}\psi_\alpha + H_{\beta\beta}\psi_\beta = E\psi_\beta$$

replacing Schrodinger's 'scalar' equation $H\psi = E\psi$ To every eigenvalue, that is energy level, E_μ, of the latter there correspond *two* energy levels of the former, E_μ^+ and E_μ^- with the eigenfunction couples ψ_α^+, ψ_β^+ and ψ_α^-, ψ_β^- respectively, $\int|\psi_\alpha^+|^2dv$ being the probability of one and $\int|\psi_\beta^+|^2dv$ of the other orientation

In the limiting case of a very strong magnetic field one gets $\psi_\beta^+ = \psi_\alpha^- = 0$,—whence the confusion between the type of orientation (α, β) and the character of the stationary state ($\pm$) As a matter of fact, these are quite different notions, the $\pm$ character of the state in question corresponding to the two possible values of the fourth (inner) quantum number, introduced by Sommerfeld and Pauli for the complete specification of the electronic orbits

Now Pauli's principle (in its original corpuscular form) requires that there should not be in the same atom two or more electrons with the same values of all the four quantum numbers This does not, however, imply—except in the case of a very strong magnetic field—that two electrons (or protons) with identical orbits should have opposite orientations

The wave mechanical formulation of Pauli's principle due to Dirac, amounts to a restriction to functions which are antisymmetrical with respect to variable quadruples x, y, z, σ for different electrons, σ denotes the spin variable taking two values, $+\frac{1}{2}$ and $-\frac{1}{2}$, say, for α and β respectively (and being interpreted as the projection of the spin moment in $h/2\pi$ units on one of the co ordinate axes) Thus in the case of n electrons a wave function $\psi(x_1, y_1, z_1\ \sigma_1, \quad , x_n, y_n, z_n, \sigma_n)$ for a given stationary state represents actually a complex of $2n$ functions of the co ordinates alone, corresponding to all possible (but in general not equally probable) orientation types of all the electrons with the same energy These functions need not, of course, be antisymmetrical with respect to the co ordinates of the different electrons

In the simplest case of two electrons which, taken separately, are specified by the eigenfunctions (or rather eigenfunction couples) $\psi(r_1, \sigma_1)$ and $\phi(r_2, \sigma_2)$ (r standing for x, y, z), the stationary state admitted by Pauli's principle is described in the first approximation by the function (or function quadruple) $\frac{1}{\sqrt{2}}[\psi(r_1, \sigma_1)\phi(r_2, \sigma_2) - \psi(r_2, \sigma_2)\phi(r_1, \sigma_1)]$ Taking for ψ and ϕ the two functions $\psi^\pm$ and $\phi^\pm$ considered above, we get *four* stationary states if ψ and ϕ correspond to different orbits (in Schrödinger's sense), and only *one* state in the opposite case, with definite probabilities both for the antiparallel and parallel spins

In Dirac's theory of the electron each state is specified not by two but by four functions, two of them (ψ_α, ψ_β, say) being large and the other two (ψ_γ, ψ_δ) small This can be interpreted by introducing along with

the two real eigenvalues of the electron's magnetic moment (or rather its projection on a given axis) $\pm\frac{he}{4\pi mc}$, two *imaginary* eigenvalues $\pm\sqrt{-1}\frac{he}{4\pi mc}$, which can be easily shown to correspond to two real values of the *electric* moment (or its projection) associated with the electron's spin (the electric moment in the corpuscular interpretation is equal to the magnetic one multiplied by $\sqrt{-1}$) The smallness of ψ_γ, ψ_δ with respect to ψ_α, ψ_β corresponds to the fact that the real part of the electric moment is equal to that of the magnetic one multiplied by v/c, v being the electron's velocity and c that of light

J FRENKEL

Physico Technical Röntgen Institute,
Leningrad, Dec 30, 1929

Rate of Vaporisation and Vapour Pressure A Method of Measuring the Specific Area of a Surface

LANGMUIR (*Phys Rev*, 2, 329, 1913) has developed a method for the determination of the vapour pressure of metals from measurements of the rate of vaporisation of metallic filaments *in vacuo* The vapour pressure is calculated from the Knudsen equation,

$$p = m\sqrt{\frac{2\pi RT}{M}} \qquad (1)$$

where m is the rate of evaporation *in vacuo*, after making the assumption, which Langmuir supports with a considerable amount of experimental data, that the accommodation coefficient is unity In this way he determined the vapour pressure at high temperatures, first of tungsten (loc cit) and later, with other workers, of platinum, molybdenum, silver, gold, copper, and nickel (Jones, Langmuir, and Mackay, *ibid*, 30, 201, 1927)

In order to determine the rate of vaporisation from unit area of the filament, Langmuir also assumes tacitly that the specific area of a metal surface is equal to the apparent area This assumption is, however, in general, not justifiable for irregularities of atomic dimensions are present to a greater or lesser extent in all surfaces (See Bowden and Rideal, *P R S*, A, 120, 80, 1928 Zwicky, *Proc Nat Acad Sci*, 15, 253, 1929 Constable, *P R S*, A, 119, 196, 1928) The work of Bowden and Rideal demonstrates that the specific area in suitable circumstances may be many times greater than the apparent area

The error involved in the vapour pressure measurements from this assumption may be calculated quite easily Let m' equal the measured rate of vaporisation from unit 'apparent' area then

$$p' = Km',$$

where K is a constant given by (1) and p' is the vapour pressure as determined by Langmuir Now if A is the ratio between the specific and apparent areas, the true rate of vaporisation from unit specific area is m'/A, and the true vapour pressure p is given by

$$p = \frac{Km'}{A},$$

that is

$$p' = Ap$$

The values of the vapour pressure determined by Langmuir's method will, therefore, be too large by a factor equal to A Further, the values of the chemical constants calculated from Langmuir's data appear to show that at least in the case of tungsten and molybdenum this correcting factor may be quite large, for the deviations from the theoretical chemical constant are $+1\ 40 \pm 0\ 50$ for tungsten, $+3\ 02 \pm 0\ 50$ for molybdenum, and $-0\ 25 \pm 0\ 40$ for platinum *If* these deviations are to be attributed *exclusively* to the factor A, it would appear that while in the case of platinum the specific and apparent areas are approximately equal, in the case of tungsten the former is approximately five times the latter, and in the case of molybdenum twenty times For the determination of the vapour pressure from the rates of vaporisation it is, therefore, necessary to know A accurately It is important to note that A is a measure of the area accessible to condensing molecules of the vaporising solid This is likely to be very different from the value of A determined, for example, by the method of Bowden and Rideal, which measures the area of a surface accessible to hydrogen ions

We have so far been concerned with the possibility of the determination of the vapour pressure from the rate of vaporisation, given that A is known It is quite clear, however, that the converse can be carried out that is, knowing the true vapour pressure and the rate of vaporisation to determine A, since A is simply the ratio p'/p of the vapour pressure p' calculated from the rate of vaporisation to the true vapour pressure p Moreover, since the true vapour pressure p can be measured accurately by some equilibrium method, such as the Knudsen effusion method, and p' can often be determined accurately from the rates of vaporisation, we have a fairly exact method for measuring A which is capable of extended application

F J WILKINS

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Jan 16

The Classification of the Primates

MR TATE REGAN's letter in NATURE of Jan 25 on the classification of the Primates, with special reference to the microstructure of the dental enamel, again raises the vexed question of Primate phylogeny Attention has lately been redirected to this problem by the reiteration of the 'unorthodox' opinions of two eminent anatomists, H F Osborn and F Wood Jones

A consideration of the conflicting points of view regarding the origin of the human stem will, I think, reveal that there are two sources of confusion which tend to prevent a lucid survey of the problem, (1) an arbitrary use of the conception of irreversibility of evolution, and (2) the careless employment of a nomenclature which is often insufficiently defined

As regards the first point, it is to be noted that, in the absence of an abundant palæontological record, the construction of a phylogenetic tree must depend almost entirely upon a study of comparative anatomy, with a proper appreciation of the distinction between primitive or generalised, and specialised anatomical characters If, in the interpretation of the anatomical data, reliance is placed on the 'law' of irreversibility of evolution, it is possible, by a sort of theoretical triangulation, to infer the nature of the common ancestor of the existing members of a natural group But if the 'law' of irreversibility be accepted at all as a basis for argument, it should be carried to its logical conclusion unless strong evidence to the contrary is forthcoming in exceptional cases Further, if *all* the available anatomical evidence is taken into account, such lines of argument will inevitably lead to the conclusion that the Catarrhines cannot have been derived from the Lemuriformes (Lemuroidea of Mr Tate Regan)—as the 'Lemuriformes' are commonly defined, nor can the Platyrrhines have been derived from the Tarsioidea—as the 'Tarsioidea' are commonly defined

In regard to the second point, the adoption of a

loose terminology in some expositions of man's evolutionary origin has evidently been the cause of much profitless controversy Terms such as 'gorilloid', 'anthropoid', 'tarsioid', and 'lemuroid', are constantly being used by different authors with different connotations It is not permissible, for example, to talk of the 'gorilloid heritage' of man, for the term 'gorilloid', unless specifically defined otherwise, can only be interpreted as an adjectival form of the word 'gorilla' which refers to an anthropoid ape with specialisations such as few anatomists can believe to have been features of the precursor of the human stem The term 'anthropoid ape', also, by its common definition, implies an arboreal animal showing certain adaptive specialisations which would presumably be absent from any form ancestral to man Unless, therefore, the term 'anthropoid ape' be given a wider application than it is usually accorded, it is highly questionable whether it is legitimate to say that man has ever evolved from a form which can be strictly called an anthropoid ape Opponents of the theory of the 'anthropoid' origin of man may, in this case, be justified in their criticisms even though they may be derided for basing the latter on what appears to be a verbal quibble Similar criticisms apply to the terms 'lemuroid' and 'tarsioid'

As Mr Tate Regan implies, the interpretation of the available data in regard to the classification of the Primates is a matter of great difficulty, and largely depends upon the taxonomic value accorded to different anatomical characters by different authorities But the problem is rendered the more difficult by the lack of a precise definition of the nomenclature commonly employed in its discussion

W E LE GROS CLARK

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A Relation between Ultra-violet Absorption Spectra and Heats of Combustion

THE ethylene linkage in the aliphatic hydrocarbons is characterised by two ultra violet bands, an intense one 1800 1900 A, and one of low intensity between 2200 and 2600 A (Stark et al, *Jahr Rad*, 10, 139, Luthy, *Zeit Phys Chem*, 107, 285, Carr, *J Am Chem Soc*, 51, 3041) The thermal equivalents ($Nh\nu$) of the two middle positions are 154 0 and 118 8 Kcal and the difference is 35 2 Kcal, this is almost identical with the difference in heats of combustion between a saturated hydrocarbon and the corresponding olefine, which for the first five members of the series is 36 8, 36 1, 36 2, 39 9, 37 2 Kcal (Kharasch, *Bur Stand Jour Research*, 2, 359) The average value for the thermochemical characteristic of the C C and C H linkage in the liquid state is 52 1 Kcal The heat of combustion of an hydrocarbon (liquid state) containing m double bonds can be represented by

$$Q - (3n + 1)52\ 1 - m(Nh\nu_2 - Nh\nu_1)$$

where ν_1 and ν_2 are the centres of the absorption bands For example, Q, calculated from Stark's data for diallyl, is 926 7 Kcal, experimental, 921 1

The only spectral measurements of acetylene hydrocarbons for which thermal data are available are those of Henri for acetylene and Stark and Lipp for acetylene and dipropargyl which are summarised as follows

	λ max	$\Delta Nh\nu$	$Q_1 - Q_2$
HC≡CH	2631		
	2040	31 4	60 1 = 2 × 30 0
$(HC{\equiv}C-CH_2-)_2$	2450		
	2010	25 5	114 4 = 4 × 28 6

The general formula would be

$$Q - (3n + 1)52\ 1 - 2m(Nh\nu_2 - Nh\nu_1)$$

where m is the number of triple bonds in the molecule

On the assumption that the band in the short ultra violet is related to the activation energy of the C − C or C − H linkage, calculations were made for the aliphatic alcohols In ethyl alcohol Leifson (*Astrophys Jour*, 63, 73) found six equally spaced bands between 2039 and 1892 A with the centre at 1952 A For alcohols in a homologous series the band is shifted 20 frequency units for each CH_2 (Henri's results) For the first four alcohols $\Delta Nh\nu$ (calculated from Bielecki and Henri's measurements) is 18 8, 18 3, 18 8, 20 4 Kcal, $Q_1 - Q_2$ is 37 8, 37 0, 38 3, 39 8, therefore $Q_1 - Q_2$ is equal to $2 \times \Delta Nh\nu$

By assuming for the aldehydes and ketones an analogous band near 1900 A, the value of $\Delta Nh\nu$ for seven ketones is 48 2 Kcal, $Q_1 - Q_2$ is 96 6 or 2 × 48 3, in three aldehydes $\Delta Nh\nu$ is 46 3 Kcal and $Q_1 - Q_2$ is 87 5 = 2 × 43 8 For compounds containing three different types of linkage the calculated values compared with experimental (in parenthesis) are, in Kcal allyl alcohol 435 8 (442 4), croton aldehyde 537 7 (542 1), mesityl oxide 844 3 (846 7), allyl acetone 869 0 (856 7), citral 1439 3 (1437 0)

A more extended treatment together with the theoretical interpretation of the relationship will appear shortly elsewhere

EMMA P CARR
(A A U W Fellow)

Physikalisch chemisches
Institut der Universitat,
Zurich, Jan 16

Raman Effect with Optically Active Substances

IT is already known from various investigations that the different isomeric forms of organic molecules give strikingly different Raman spectra A noteworthy case is that of the cis and trans forms of dichlorethylene, which have been studied by Bonino and Brull (*Zeit fur Physik*, 58, p 194, 1929) These investigators have found that the most striking differences appear in the characteristic molecular frequencies lying in the remote infra red and made so readily accessible to observation by the Raman method

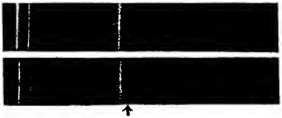

FIG 1 —Raman spectra of lævo- (upper) and dextro pinene (lower)

It is evidently of great theoretical importance to ascertain whether optical isomers, that is, the dextro and lævo rotatory forms of the same molecule, give spectra which differ in any respect To test this question, the two optically isomeric forms of pinene were examined The materials as supplied by Kahlbaum were carefully purified by fractionating at constant boiling point (154° C) All the numerous Raman lines which appear in the scattering by the dextro isomer are also observed with the lævo form and vice versa, and in identically the same positions, as we should expect There are, however, appreciable differences in the relative *intensities* of some of the lines This is particularly conspicuous in the case of

the Raman line corresponding to an infra-red wave-length of about 74μ marked by an arrow in the photographs reproduced in Fig 1, which is conspicuous in the dextro form and scarcely visible in the lævo form This result is sufficiently surprising, and is therefore put forward with all due reserve Nevertheless, the authors feel reasonably confident of its reality

Further work has been undertaken to study other optically active substances (both fluid and crystal line) It is also proposed to investigate whether the state of polarisation of the light has any influence on the observed results

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S VENKATESWARAN

210 Bowbazar Street,
Calcutta, Dec 28, 1929

The Gibbs-Ewald Reciprocal Lattice

THE Gibbs Ewald reciprocal lattice is now of such general use in the discussion of problems in crystal physics that it seems worth while to record a simple analytical expression for its definition

The usual vector definition of the reciprocal lattice is expressed by the relations [1]

$$(\mathbf{b}_i\mathbf{a}_i) = 1 \qquad (\mathbf{b}_i\mathbf{a}_k) = 0 \qquad i \neq K,$$

where $\mathbf{a}_i$ refers to the vector defining any one of the primitive triplet of translations of the crystal lattice, and $\mathbf{b}_i$ refers in a similar way to the primitive triplet of the reciprocal lattice

I now suggest an equivalent formula of a purely analytic type Let us consider the equation

$$e^{2\pi i\sum_1^3 u_i x_i} = 1,$$

and discuss the simple case in which the x_i are the co ordinates of a point referred to orthogonal axes We now consider another space referred to similarly situated axes in which the co ordinates of a point are u_i To every point u_i in the second space, there corresponds an infinite number of planes

$$u_1x_1 + u_2x_2 + u_3x_3 = n,$$

where n is an integer The distance between any two adjacent planes is equal to $n/(u_1^2 + u_2^2 + u_3^2)$ If now we apply the law of rational indices to specify the crystallographically possible planes, we see that the values of u_i are then the co ordinates of the points of the reciprocal lattice as usually defined

For the discussion of the case of oblique axes, the tensor form of the equation is probably the simplest We write immediately

$$e^{2\pi i x_i x^i} = 1,$$

where the x_i are the covariant components of the vector x the contravariant components of which are x^i The co ordinates in the reciprocal space can then be associated directly with the covariant components of the co ordinate vector in the original space [1] In the use of the tensor form it is interesting to make use of an affine co ordinate system [2] of constants a, b, c, and angles α, β, γ, appropriate for the crystal under discussion

I hope to develop the present transformation and also the more general transformation expressed by the equation $F(x_i x^i) = 0$ in connexion with the Fourier integral transformation previously published [3]

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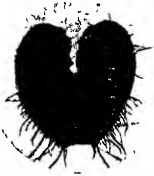
[1] P. P Ewald: 'Handbuch der Physik', 24, 241 (Springer, 1927)
[2] E Madelung 'Mathematische Hilfsmittel des Physikers", p 85 Springer, 1925)
[3] A L. Patterson. *Zeits f Phys*, 44, 596, 1927.

The Blowfly's Mouth

THE proboscis of the blowfly has been so often figured and described that students generally have no difficulty in understanding its structure and mode of working There is, however, one small ambiguity that beginners are liable to find somewhat perplexing, especially when only balsam preparations are used, namely, the use of the word mouth to describe the opening in the centre of the terminal disc That this opening is not the mouth in the sense of being the entrance to the pharynx is apparent when one dissects a well distended proboscis that has been cleared in potash If the disc is snipped off and examined under water without pressure (see Fig 1), the opening is



Photo] [*J Manby*
FIG 1 —Disc of blowfly's proboscis

found to be identical with the gap lying between the two lobes (*labella*), particularly with the small central region, which is nearly but not quite partitioned off from the upper part and which is continuous behind with the channel like groove in the haustellum

If the name mouth is retained for this region of the disc, the question arises what the aperture at the other end of the haustellar groove should be called Unlike the gap in the disc, this small and deeply placed aperture is concealed from view and somewhat troublesome to find unless the overlying parts be first removed When this is done—when, for example, the haustellum is cut away—the aperture is seen lying between the epi- and hypopharynx at the end of the rostrum, and since, besides being associated in this manner with appendages that are plainly oral in character, it opens directly into the front portion ("buccal cavity", Patton and Cragg) of the pharynx there seems to be good reason why it, rather than the opening in the disc, should be called the mouth

T H TAYLOR
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Leeds

Organic Chemistry at University College, London

IT is now an open secret that the Academic Council of the University of London is being moved not to appoint an eminent organic chemist to succeed Prof. Robinson in the chair of organic chemistry in University College, London, but to fill the two chairs of chemistry in this institution by distinguished physical chemists The acceptance of such a fantastic proposition would disturb the balance of natural philosophical studies in University College so profoundly that immediate public protest is necessary, and the more so in that organic chemistry is not directly represented on the Academic Council

Physical chemistry is a modern subject, its achievements, based, on one hand, upon the recent rapid

developments in physics, and, on the other, upon the vast accumulation of experimental facts of inorganic and organic chemistry, have led to great advances in pure and applied chemistry But when the pure physics and the pure chemistry are removed, little is left of physical chemistry as an individual science This border line subject, indeed, could not exist without its essential props of physics and chemistry

Meanwhile, organic chemistry pours out, through its research workers, a stream of new facts far broader than that issuing from physical chemistry its problems, particularly of biological significance, are becoming more fascinating and more profound, and its experimental technique is growing in intricacy and certainty The Royal Society continues with fair regularity to elect annually one organic chemist and one from the inorganic or physical side to its fellowship, the great chemical societies, the world over, still publish many more papers on organic than on physical chemistry It is becoming increasingly more difficult to find young organic chemists to meet the ever growing needs of the research laboratories in our great industrial organisations

Until the advent of the day when the mathematical physicist shall have rendered obsolete the experimental worker in inorganic, organic, and physical chemistry, and indeed also in physics and biology, the suppression of the chair of organic chemistry in so broad a science school as that of University College, London, will be an academic disaster

W J POPE

Cambridge, Feb 8

SIR WILLIAM POPE's letter raises an issue of such importance to the future of chemistry in Great Britain that every effort should be made to place the position before the University authorities before any final and irrevocable step is taken

During the last decades of the past century the condition of organic chemistry in Great Britain was such that many of our younger chemists had to go to one or other of the great continental universities to learn the science At the present time all that is changed, and schools of organic chemical research are established in all our chief universities From these, as Sir William Pope has said, there issues a steady stream of published research comparable in quality and quantity with that emanating from any other country We must, therefore, be careful not to take any action which may set the clock back forty years and lead to a state of affairs which will again place us in the hands of the great research schools abroad

Indeed, it is almost incredible that this could now happen, although a retrograde action, such as that mentioned in Sir William Pope's letter, would undoubtedly deal a serious blow to organic science by preventing the more brilliant of the younger men from adopting a branch of chemistry which was considered in some quarters to be moribund Such a view is, moreover, so alarming that unless one had heard it expressed in conversation one would hesitate to trouble readers of NATURE by suggesting that any justification of organic chemistry is either necessary or desirable

Nevertheless, the people who have to decide these grave issues are not necessarily chemists, and a short article in NATURE dealing with the present position and prospects of organic chemistry would certainly bring enlightenment to many Advantage of the occasion might also be taken to refer to the admirable address given by the president of Section B at the recent South African meeting of the British Association I should add that I am writing this letter in my personal capacity and not as president of the Chemical Society

JOCELYN THORPE

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London, S W 7

X-Ray Measurements with a Plane Diffraction Grating

RECENTLY Prins [1] computed the Porter correction [2] for Bearden's wave length value,[3] and found it amount to half the difference between Bearden's value and that obtained from crystal measurements, which is 0 23 per cent

1 With some necessary assumptions I have computed the same correction to 0 0007 per cent for Bearden's and to 0 002 per cent for my own value,[4] which was also mentioned

2 It is to be noticed that this correction increases the difference, and that the function of the slits in these cases only is to screen off sufficiently narrow beams

3 Effects as those calculated by Fagerberg [5] also seems to have had little influence on my value Variations in the wave lengths which may depend upon such variations of the grating constant, could not be observed As already indicated in my dissertation, the variations obtained were all explainable as accidental errors in the measurements of the plates

ERIK BÄCKLIN

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Uppsala

[1] J A Prins NATURE, Sept 7, 370 1929
[2] A W Porter, *Phil Mag*, 5, 1067 1928
[3] J A Bearden *Proc U S Nat Ac Sci* 15, 528, 1929
[4] E Bäcklin Inaug Diss Uppsala Universitets Årsskrift, 1928.
[5] S Fagerberg, NATURE, Jan 4, p 13

Dr Sebastian Z de Ferranti

DR FERRANTI was a valued member of the National Physical Laboratory Committee entrusted with the supervision of the experiments made possible by the use of the high tension equipment supplied by his firm We shall miss his advice greatly There is, however, a slip in the admirable account of his work in NATURE for Feb 1, p 172, which he would have been the first to wish to see corrected According to the Report of the High Tension Committee, printed in the Report of the National Physical Laboratory for 1928, p 163, "The high voltage transformers were supplied by Messrs Ferranti, Ltd, to the design of Messrs E Haefly and Co, S A of Bâle, who constructed certain parts"

R T GLAZEBROOK

Ballards Oak, Limpsfield,
Surrey, Feb 3

"Encyclopædia Britannica"

IN volume 22 of certain sets of the new edition of the "Encyclopædia Britannica" there is an article on Tides, beginning at the foot of page 193 and ending in the first column of page 204 In the list of authors this article is ascribed to me, and it is true that it is founded on a MS prepared by me But I am not responsible for the article as it is printed, and I should be very grateful to be allowed to use the columns of NATURE to say so

I am informed by the publishers that other sets of the 'Encyclopædia' contain a very different article, of which I do acknowledge authorship

J PROUDMAN

The University, Liverpool,
Feb. 3

Tanning Materials of the British Empire

By Prof. JOHN READ

THERE is much truth in the old saying that there is nothing like leather; and one rejoices that the tanner continues to thrive in an age which has produced substitutes for so many of the common commodities and witnessed the decline and extinction of so many of the ancient crafts. The exceptional calls which were made upon the leather industry during the War led to an enormous demand for tanning materials, but even under the more settled conditions of the last few years the consumption has shown a steady increase. The total value of such materials used in Great Britain in 1928 was £2,413,000, of which more than half was imported from foreign countries; this position cannot be considered satisfactory when the supplies available within the British Empire are reviewed.

The examination of tanning materials has taken an important place among the many valuable series of investigations which have been conducted at the Imperial Institute upon natural products from all parts of the Empire. In 1926 an Advisory Committee on Tanning Materials was constituted, and a recent publication[1] prepared by members of the Institute staff, affords a general account of the chief tanning materials of Empire origin, together with a useful bibliography, and statistics and graphs illustrating consumption and prices in Great Britain. The review includes materials which show promise, in addition to those which have already secured recognition; the classification is under the headings of barks, woods, leaves, fruits, tubers, and miscellaneous materials.

The chief tanning materials grown in Great Britain are oak and larch barks; the combined annual production of about 10,000 tons furnishes, however, only about 7 per cent of the total supply of tannin required for domestic industrial purposes. In spite of its slow rate of penetration into the hide and its high cost, oak bark tannin is used extensively in producing the best grades of heavy leather. The best English oak bark, grown in Hampshire and Sussex, yields 12-14 per cent of tannin, while good European samples contain 10-13 per cent. Tannin extracts are prepared on the Continent and in North America also from oak wood, which contains 5-13 per cent of tannin; moreover, the cups of the acorns of *Quercus Ægilops*, with a content of more than 30 per cent, are imported extensively from Asia Minor and Greece under the name of valonia. Within the Empire, oaks occur notably in India, Burma, and New Guinea, but it is in the last named country only that the possibility of utilising the bark or wood as a source of tannin appears to offer promise.

In 1928 the two main vegetable tanning materials used in Great Britain were quebracho (extract) and myrobalans, and these were followed closely by wattle (bark and extract) and chestnut (extract). A glance at the sources of these four materials reveals several points of much interest. Quebracho extract is imported exclusively from the Argentine, and the value of this trade has increased from £142,000 in 1913 to £669,000 in 1928. There appears to be no fundamental objection to the replacement of much of this material by Empire tannins. Myrobalans, the astringent fruits of various species of *Terminalia*, are produced extensively in India. The combined value of the fruits and extract used in Great Britain in 1928 was £381,000, and shipments of almost equal value were made from India to the United States. The pyrogallol tannin of myrobalans has a low rate of penetration and produces a spongy leather; it has consequently been blended with quebracho and other tannins with greater astringency and penetrative power. "Experiments conducted with Empire tanning materials during the War, when there was a shortage of foreign supplies, established the value of the mixed tannage of myrobalans and wattle bark. The astringent, readily penetrating wattle liquors are mellowed by the addition of myrobalans which, through natural fermentation, provide the necessary degree of acidity, and render the leather brighter in colour while diminishing its tendency to become red on exposure to light."

Wattle bark is one of the most abundant and widely used tanning materials of the Empire, and its increasing popularity has led to a careful consideration by the Imperial Institute Advisory Committee of its actual and potential sources of supply. In Australia, the native home of the wattles, there are more than four hundred indigenous species, of which the most important for commercial purposes are *Acacia pycnantha* (the 'golden wattle' of South Australia) and *A. mollissima* (the 'black wattle', a variety of *A. decurrens*). The best commercial specimens of golden wattle bark ('Adelaide bark') contain about 38 per cent of tannin, but in some instances the air-dried material yields as much as 50 per cent, so that *A. pycnantha* provides one of the richest known sources of tannin. Black wattle bark sold in the Sydney market gives an average tannin value of about 30 per cent, unless it has been mixed with the inferior bark of the silver wattle (*A. dealbata*).

At the beginning of the century, Australia enjoyed a thriving export trade in wattle bark, but in 1926–27 the total exports of tan barks (consisting largely of mallet bark from *Eucalyptus occidentalis*) amounted only to £4010. Moreover, in the same year the excess of imports over exports of tan barks reached £23,674. Australia, by virtue of its profusion of wattles, *Callitris* 'pines', eucalypts, and mangroves, possesses unrivalled natural sources of astringents; and yet the paradoxical position has arisen that the Australian leather industry is dependent upon imported tanning materials produced from Australian species of *Acacia* which have been cultivated in South Africa. The decline in the Australian industry is due to a combination of factors, such as wages, labour supply, depletion of natural forests, and lack of market for the wood.

[1] "Tanning Materials of the British Empire." Reprinted from the *Bulletin of the Imperial Institute*. London: Murray, 1929. Price 2s.

Of the total financial return from a wattle plantation in Natal, 56 per cent was derived from the sale of bark, 33 per cent from mine props, and 11 per cent from fuel Natal, which is now one of the main centres of the wattle bark industry, offers a favourable climate for the cultivation of the black wattle, and at present cheap native labour is available for stripping and handling the bark ' According to the secretary of the Wattle and Timber Growers' Association, the present value of the South African wattle industry may be assessed, at a conservative estimate, at £2,000,000 a year, of which more than half is money brought into the country by the export of bark and extract " It is therefore not surprising that the Forest Department of the South African Government has organised a comprehensive scheme of sylvicultural research, dealing with growth measurements, standard yields, optimum age, incidence and extent of insect attacks, fertilisers, etc Encouraging results have also attended the experimental cultivation of *A mollissima* and other species in Kenya Colony, Tanganyika, and India

Chestnut extract is produced mainly from the wood, which when air dried contains about 8 13 per cent of tannin The chief producing countries are France, Italy, and the United States, and of the overseas countries of the British Empire only India and Burma offer possibilities for the exploitation of species of chestnut as sources of tannin Researches carried out at the Forest Research Institute at Dehra Dun have indicated that trees from Burma yield a richer extract than the European trees, but it is doubtful whether the product could be marketed economically under the prevailing conditions

In these remarks it has been possible to comment only upon a few of the many facts, figures, and investigations finding mention in an unusually interesting publication, which, we are informed, has already been published on the continent in the form of a German translation

Research in Freshwater Biology and the Functions of a Freshwater Biological Station

By Prof F E FRITSCH

FRESHWATERS are put to many different uses Primarily they are the source of domestic water supplies, including the huge amount of water required for sanitary purposes Fresh water is, further, employed in enormous quantities in most, if not all, manufacturing processes Flowing water is increasingly used as a source of power, while many British waterways serve as a means of communication An appreciable section of the population, moreover, find relaxation in freshwater fisheries, while many a lake or stream is the centre point of a beauty spot

At the same time streams (and sometimes other kinds of waters) serve as the natural recipients of sewage, only too often incompletely purified, and of the waste effluents from a great diversity of chemical works and factories During the course of the nineteenth century the quick growth of urban populations and the rapid industrial development combined, as a consequence, to bring about a very serious state of pollution in many British rivers, with the result that fish life was appreciably diminished, and certain kinds, like salmon and trout, disappeared altogether from the more strongly polluted waters This led to the appointment of a series of Rivers Pollution Commissions, which sat from 1865 onwards, and the reports of which are classical pieces of work which gave to Great Britain a lead of thirty to forty years in water investigation Yet, since then, and particularly on the experimental side, we have been far outdistanced by other countries In the present century, and especially since the War, however, public opinion has again become alive to the evils attendant upon wholesale water pollution, and various committees have been set up to deal with the matter Among these, special mention may be made of the Standing Committee on Rivers Pollution appointed by the Ministry of Agriculture and Fisheries in 1921, and the Water Pollution Research Board established in 1927

The three non technical reports published by the former Committee (1924-26) contain abundant references both to the lack of scientific knowledge on the organic life of stream and lake and to the need for its acquisition In the second report (p 19) it is emphasised as essential that ' those responsible for the work of river regeneration should have at their disposal the fullest scientific information bearing on the subject ", whilst on p 24 the same report continues " At bottom, the problem is doubtless a question of the balance between all the different forms of animal and vegetable life under the particular environmental conditions which prevail ", and (p 12 of the third report) " it is upon the abundance and well being of these small organisms that the fish life ultimately depends "

It is, however, not merely in relation to pollution and fisheries that a complete knowledge of the biology of British freshwaters must be of paramount economic importance It is no less essential from the point of view of domestic water supplies, while ignorance on this subject is no doubt often the unrecognised cause of difficulties or deficiencies in various manufacturing processes in which water plays a considerable rôle Moreover, a biological treatment of the effluents may well become a practicable matter in certain cases Nor can it be doubted that fish-breeding would profit from a more adequate knowledge of aquatic biology

What, then, is the state of our knowledge as regards the biology of freshwaters in general and of our own in particular? Professional biologists and amateur naturalists have done much to acquaint us with the multifarious aquatic fauna and flora, but there are immense gaps in our knowledge Collecting has been carried out mostly during the warmer period of the year, and few data are available as regards

the fauna and flora during the winter months Again, the organisms that thrive in the deeper water of rivers and lakes, and especially those that inhabit the stream-bed or the lake-bottom, are, as a result of their relative inaccessibility, very imperfectly known Our ignorance in this respect is much greater on the botanical than on the zoological side A recently published account of the attached algal communities of certain British streams includes the description of a new genus and several new species, and analogous investigations in other quarters would probably afford a like result We are thus at the present time quite inadequately familiar with the organisms that occur in freshwaters, yet whose individual presence or absence may be an index of the purity of the water and the cause of important biological changes Our knowledge of the life histories, except in a very few forms, is incomplete, and in only too many cases nil

Moreover, although at present only clearly demonstrated for small ponds and for the macroplankton communities of larger waters, it is apparent that the microscopic fauna and flora exhibit a very definite annual periodicity and one, too, that varies appreciably in successive years Such variations in the amount and time of occurrence of the diverse organisms are certainly an expression of corresponding variations in the environment, and by correlating the two, a number of important hints as to the causes underlying the appearance and extent of development of the various denizens of a piece of water are to be obtained

Conclusions of this kind, however, require to be supported by experiment and by a far more comprehensive chemical and physical analysis of the environment than has hitherto been undertaken Such work would lead to results of fundamental value, not only from the purely academic point of view, but also because it would provide means of controlling to some extent the nature and degree of development of the organic life in freshwaters

Again, we possess at present but very fragmentary ideas as to the interrelationships of the diverse animal and plant communities in lake and stream Although data may be available as to the direct food of certain fish, the nature of the nutriment upon which their prey in its turn relies for sustenance is almost always unknown Birge and Juday, working on the lakes of Wisconsin, have shown the great importance of the nannoplankton which furnishes a large proportion of the available organic food Of the nature and extent of the nannoplankton in other waters, however, practically nothing is known Nor are the interrelationships of the organic communities of freshwaters merely a question of food relations

The diverse problems just indicated are not by any means the only ones awaiting solution in the realm of aquatic biology, but have been selected because they are perhaps the most obvious They are of a similar nature in many kinds of water, and a long stride will have been taken towards their solution by the selection of a typical area of freshwater for intensive investigation over a period of years For this purpose a properly equipped laboratory, with a permanent staff of scientific workers, needs to be established in the immediate vicinity of one or more suitable water-surfaces The problems are not such as can be solved by occasional visits followed by work in a university laboratory, but in practically all cases require daily observations and records made on the spot Even a water sample does not remain the same if carried some distance before analysis

The staff of such a laboratory would make it their business, not only to become acquainted with the fauna and flora all the year round, but also would undertake regular chemical and physical investigation of the water in order to correlate changes in the one with changes in the other Plentiful experimental work would be necessary in order to substantiate the conclusions thus arrived at Moreover, a detailed study of the life history of many of the organisms present would have to be undertaken, since their whereabouts and state of existence during the 'absent' period would in many cases, no doubt, prove to have a direct bearing on their time of maximum abundance An important function of such a station would further be to initiate new methods of limnological investigation and to test the efficacy of those in current use

Freshwater biological laboratories of this kind have long been in existence on the continent, among the more important being those of Plön in Germany, Lunz in Austria, and Aneboda in Sweden, all supported by public funds and growing in importance year by year While the work at such stations should primarily be of the nature of fundamental pure research, it is highly desirable that those concerned with applied problems should already, at an early stage, occupy working places in the laboratory While they may obtain considerable help from the permanent scientific staff, the latter would profit greatly from contact with the economic problems that have to be solved

It is not considered necessary to stress the scientific importance of such an institution, which was made sufficiently clear in the widely attended joint discussion between sections D and K at the Glasgow (1928) meeting of the British Association on "The Biological Investigation of British Freshwaters" An additional point to be made, however, is that a station of this kind would soon furnish a quota of limnological workers who could be drawn upon for the solution of applied problems, whilst it would stimulate work in other parts of the Empire and provide instruction in modes of attack

It is with the prime purpose of securing the establishment of such a laboratory that the Freshwater Biological Association of the British Empire (inaugurated at a meeting held in the rooms of the Linnean Society of London in June of last year) has been founded In order to arouse public interest and to initiate the raising of the necessary funds, the Council of the Association has invited all interested parties to a meeting to be held at 2 30 P M on Feb. 21 next, at Fishmongers' Hall, by kind permission of the Court of the Fishmongers' Company The chair will be taken by the Right Hon Lord Rothschild, president of the Association.

Obituary.

MAJOR P A MACMAHON, F R S

ON Christmas Day of last year, Major Percy Alexander MacMahon died at Bournemouth By his death, the science of pure mathematics has lost a distinguished devotee with a striking individuality Not that MacMahon was solely a scientific investigator He had been a soldier, he retained the title of his military rank to the end of his days He had been engaged in teaching for not a few years, his powers of exposition were marked by a clear directness that could be envied He had been a Civil Servant, for fourteen years, until his retirement in 1920 under the age limit, he was Deputy Warden of the Standards of the Board of Trade But throughout all the stages in his varied avocations, MacMahon achieved and maintained a high reputation as a pure mathematician

The outward facts of MacMahon's life may be recorded briefly Born at Malta on Sept 26, 1854, he was the second son of Brigadier General P W MacMahon His school was Cheltenham on leaving school, he went to the Royal Military Academy at Woolwich and entered the Royal Artillery in 1872 He was professionally connected with that arm for many years until he was of standing for promotion to colonelcy, but he abstained from qualifying for promotion, and he retired with the rank of major Some early years of military duty were spent in India On his return to England he was drafted into the educational side of military training He was appointed an instructor in mathematics at Woolwich in 1882 there, he was a colleague of his former teacher, Prof A G (afterwards Sir George) Greenhill, for whose powers he ever retained the highest respect Later, in 1890, he was appointed professor of physics in the Ordnance College, and from 1904 to 1920 he was attached to the Board of Trade, in the office already mentioned

Concurrently with all these successive professional occupations, MacMahon was diligently engaged in research In no long time he had established a mathematical reputation by his investigations, published in the *Quarterly Journal of Mathematics*, the *Proceedings of the London Mathematical Society*, the *American Journal of Mathematics*, and the *Proceedings of the Royal Society* Soon, a gradually growing share in the official activities of learned societies was assigned to him He was elected a fellow of the Royal Society in 1890 was president of the London Mathematical Society in 1894–96 was president of the Royal Astronomical Society in 1917 and for many years, either at intervals, or for long continuous periods, he was a member of the respective councils of those bodies He also acted as a General Secretary of the British Association for twelve years in 1914 he was appointed a Trustee while in 1901, at the meeting in Glasgow, he was president of Section A (Mathematical and Physical Science) of that body, delivering an interesting address upon the general aspects of the subjects of his own mathematical preference

The value of MacMahon's original work was widely recognised by the conferment of honours, such as academic and scientific corporations alone can worthily confer Unconnected with any university by training, he received a number of honorary degrees, he was made doctor of science by Dublin in 1897 and by Cambridge in 1904, and doctor of laws by Aberdeen and by St Andrews in 1911 It is no secret that he was all but appointed Savilian professor of geometry in the University of Oxford in succession to Sylvester, on the latter's death in 1897 In his later years, until his health broke down in 1928, when he removed to the south coast of England, he and his wife settled in Cambridge After his honorary doctorate, and by express invitation, he had joined St John's College, Cambridge, a college including in its foundation many personal friends such as the present Master (Sir Robert Scott), Sir Joseph Larmor, and Prof H F Baker, among the mathematicians

Nor were scientific honours less profuse than those of an academic quality MacMahon was elected an honorary member of the Royal Irish Academy and of the Cambridge Philosophical Society The Royal Society appointed him its representative as a governor and fellow of Winchester, and awarded him a Royal Medal in 1900 and the Sylvester Medal in 1919 The London Mathematical Society awarded him the De Morgan Medal in 1923

Thus MacMahon's military career had gradually merged into avocations connected specially with pure science and the worth of his scientific life had met with ample recognition But the real crown of his scientific life is constituted by the additions to knowledge which he achieved in the course of his mathematical investigations

MacMahon's contributions to mathematical science are contained in many separate memoirs, more than one hundred in number, and in one treatise on the grand scale, his 'Combinatory Analysis" in two volumes, published (1915, 1916) by the Cambridge University Press The development of his genius, when once he had settled into his main region of original research (and he settled early), was swift and clear, as exhibited by the sequence of topics in his memoirs regarded chronologically, and that development was maintained with a continuity which was remarkable and persistent His earliest papers were rather scattered in their subjects he dealt with isolated topics, with some properties of special curves or the integrations of some differential equations connected with elliptic functions But very soon his true line had been found thereafter, progress was steady and unhalting

His real beginning was made not later than 1883 by a simple discovery which opened up a new field of investigation and completely transformed one range of the theory of invariantive forms, created and amplified by Cayley, Sylvester, and Hermite In that theory it had long been known that any seminvariant—that is, an invariant or the leading coefficient of a covariant—of a binary quantic of quite general rank satisfies a central linear partial differential equation of the first order, which depends

solely upon the parametric coefficients of the quantic It was also a matter of established knowledge that, subject to one proviso, a symmetric function of the roots of an algebraic equation of quite general degree satisfies another linear partial differential equation of the first order, which likewise depends solely upon the parametric coefficients in the equation The limiting proviso is that the partition of the symmetric function must be non unitary that is to say, if the symmetric function of the roots $\alpha, \beta, \gamma,$ of the equation be denoted by the expression $\Sigma\alpha^p\beta^q\gamma^r$, no unit integer shall occur in the partition $p, q, r,$ of the number $p+q+r+$ which is the weight of the function

MacMahon's discovery (hailed as 'very remarkable' by Cayley) was that, by mere arithmetical changes connecting the coefficients of the quantic $(a_0, a_1, a_2, \quad)(x, 1)^n$ with the coefficients of the equation $c_0x^n + c_1x^{n-1} + c_2x^{n-2} + \quad = 0$, the critical differential equation satisfied by the seminvariants of the quantic becomes identical with the critical differential equation satisfied by the non unitary-partition symmetric functions of the roots of the equation These arithmetical changes, by which the coalescence is effected, are

$$a_0 = c_0,\ a_1 = 1!c_1,\ a_2 = 2!c_2,\ a_3 = 3!c_3,$$

The property, thus discovered, entails the consequence that seminvariants of the quantic and non-unitary partition symmetric functions of the roots of the equation are formally equivalent, if the foregoing relations hold between the two sets of coefficients For example,

$$a_0^2\Sigma\alpha^2 = a_1^2 - a_0a_2,\ 2a_0^3\Sigma\alpha^3 = -(a_0^2a_3 - 3a_0a_1a_2 + 2a_1^3),$$

$$12a_0^2\Sigma\alpha^2\beta^2 = a_0a_4 - 4a_1a_3 + 3a_2^2$$

Thus seminvariants of a quantic can be treated as non unitary partition symmetric functions of an associated ordinary algebraic equation This range of invariantive forms can therefore be constructed from the results of the pure algebra of symmetric functions, the weight of the form being the same as the weight of the function In turn, by its dependence on the non unitary partitions of the weights, this pure algebra invokes the theory of the partitions of numbers MacMahon's initial discovery thus made a link between the theory of invariants and one branch of the theory of numbers As invariants can arise through continuous variation of the magnitudes which occur, while partitions are necessarily concerned with discrete magnitudes, all the cognate work established another connexion between the calculus of continuous quantity and the calculus of discontinuous quantity

The ensuing researches had one important, almost an immediate, result Progress in the theory of covariantive forms had, to some extent, been barred through lack of a complete mastery over the syzygies, that is, the homogeneous relations among the seminvariants But owing to this new correspondence between seminvariants (or perpetuants, as Sylvester styled them) and the non unitary-partition symmetric functions of the roots of an equation, the syzygies in question were transferred to the region of the selected symmetric functions The last can be enumerated by means of the partitions, the relations, which connect them, are established by algebra of a simple character initiated by Newton and the calculations thus became matters of pure arithmetic and algebra

The way thus was indicated for a new algebraical proof of one theorem of fundamental importance—the finiteness in number of the aggregate of the asyzygetic concomitants of a binary quantic, it had previously been known only by Gordan's proof, which used the methods of umbral representation By Cayley and MacMahon, among others, especially in relation to syzygies, to generating forms, and to ground forms, the algebraic work was developed By MacMahon himself, utilising earlier researches of Sylvester and others on the partition of numbers (and, as a happy incident, securing for publication some forgotten unedited lectures of Sylvester on the subject) a full development of partitions in general, with many ramifications and amplifications, was revealed The work was (what, in another connexion, Sylvester had called) a new world of analysis

Accounts of the work, while still it was in progress, will be found (though with much self effacement) in MacMahon's presidential address to the London Mathematical Society (*Proc Lond Math Soc*, vol 28, pp 5 32, 1897) in 1896, and in his address as president of Section A at the Glasgow meeting of the British Association in 1901 (British Association Report ", pp 519 528, 1901) Memoir succeeded memoir in his consecutive development of the theory over a number of years He dealt with matters apparently so diverse as symmetric functions, differential operations and their comparative effects partitions of numbers, unipartite and multipartite, their separations and their compositions permutations, in a multitude of associations Euler's Latin squares, magic squares, ancient and modern diophantine equations and inequalities enumerating (or generating) functions, in their persistent emergence throughout the theory Finally, he produced a systematic account of all this work, including cognate investigations of other writers, in the treatise 'Combinatory Analysis ", cited earlier It is a fitting and an abiding monument to his genius

Nor did MacMahon disdain the lighter issues of his work It admitted of illustrations and applications that can appeal (though, as the world estimates pure mathematics, too seldom do appeal) to those who are unversed in mathematical phraseology and mathematical conclusions Thus he delivered an almost untechnical lecture on "Magic Squares and other Problems on a Chess-Board" as a Friday evening discourse at the Royal Institution on Feb 14, 1902 At the same place, on the afternoons of Jan 30 and Feb 7, 1907, he lectured on "Standards of Weights and Measures" His interest extended to special problems such as finding the totality of ways of seating a number of married couples at a round table dinner party, so that each lady sits between two gentlemen and no lady is next her husband He found relaxation and amusement in using the ideas of combinations and permutations for the construction of ingenious

(yet not useless) pastimes Thus, to select one instance, full sets of pieces of cardboard are required all the pieces of a single set are to be of the same shape (usually triangular, or square, or hexagonal) and of the same size they are to be coloured, each, for example, with three out of four colours, while no two are to be coloured in exactly the same way By the adoption of definite rules for combining the pieces of a set, a large number of different forms can be obtained, each such form being a geometrical pattern Each pattern can be repeated so as to provide a general symmetric design The designs can be utilised in a variety of ways for humble wall paper, for mosaics and woven fabrics, for the refined ornament of architecture In a small volume entitled "New Mathematical Pastimes", published in 1921 by the Cambridge University Press, he gave an account of these recreations, at once light and serious the contents are entirely his own creation

MacMahon's investigations extended over nearly half a century Many in number, diverse in range, they constitute a fine contribution to his science, and they assure him an honourable place among the prominent pure mathematicians of his generation

A R F

PROF T BRAILSFORD ROBERTSON

NEWS has been received of the death on Jan 25, from septic pneumonia, of Prof Brailsford Robertson, of the University of Adelaide His premature death, at the comparatively early age of forty five years removes one of the most active and valuable workers from biochemical research, and is a very serious loss to the recently instituted movement for the more rapid application of biological knowledge to the development of animal husbandry in Australia

Thorburn Brailsford Robertson was educated at the University of Adelaide In 1904, attracted by the work of the late Jacques Loeb at the University of California, he went there as a research student in biology and for several years worked in close collaboration with Loeb, and eventually succeeded him as professor of biochemistry and pharmacology at Columbia University in 1916 In 1918 he was called to the chair of biochemistry at the University of Toronto in succession to Prof A B MacCallum, and in 1920 he returned to Adelaide as professor of biochemistry and general physiology in succession to his father in law, the late Sir Edward Charles Stirling

From 1920 until the time of his death, Prof Brailford Robertson occupied a prominent position in Australian biological science, both in pure research and in the application of the results of research to industrial problems He was one of the founders of the *Australian Journal of Experimental Biology and Medical Science* When the Commonwealth Council for Scientific and Industrial Research was instituted a few years ago, he was invited to become the chief officer in charge of investigations on the nutrition of animals To enable him to devote the major part of his time to this work, he was relieved of teaching at the University, though he continued to be a member of the Senate, so that his experience might be available in developing the school of biochemistry and physiology at the University

Prof Robertson was an assiduous worker and a prolific writer He did most important work on the physical chemistry of the proteins, and later conducted long and laborious research on problems of growth and senescence Among the problems of general physiology to which he made valuable contributions may be mentioned allelocatalysis as a factor in the multiplication of infusoria, the permeability of cells and the underlying physico chemical principles involved in cell division In addition to numerous papers in scientific journals, he published "The Principles of Biochemistry" and other two works, namely, 'The Physical Chemistry of the Proteins" and 'The Chemical Basis of Growth and Senescence", in both of which he incorporated the results of his own original work on these subjects

Prof Robertson had a stimulating personality, and, as a lecturer, had the gift of imparting his new enthusiasm to his audience His death will be deeply regretted in scientific circles, especially in North America and Australia, in both of which continents he exercised a great influence in the development of biochemistry, both as a science and in its application to practical problems The loss of his profound scientific knowledge and great experience in organisation will be a very serious blow to the work of the Commonwealth Council for Scientific and Industrial Research

J B O

MR F P RAMSEY

THE death on Jan 19 of Frank Plumpton Ramsey at the early age of twenty six has cut short a life which bore exceptional promise of eminence in mathematics and philosophy The elder son of Arthur Stanley Ramsey, now President of Magdalene College, and the author of well known treatises upon subjects in applied mathematics, Frank Ramsey was born in 1903 and passed his boyhood in Cambridge From King's College Choir School he became first a scholar of Winchester, and then a scholar of Trinity College, Cambridge in 1923 he graduated in the first class of the Mathematical Tripos, with distinction, and in 1924 was elected to the Allen (University) Scholarship At the time of his death he held a University lectureship in the Faculty of Mathematics, and was a fellow and director of studies at King's College, Cambridge

It could not be expected that Ramsey's published work would fill a large number of pages, yet there is enough to prove the distinction of his mind and powers The London Mathematical Society has printed two weighty papers, "The Foundations of Mathematics" (1926) and "On a Problem of Formal Logic" (1929) The former, written after Ramsey had become acquainted with the work of Wittgenstein, is probably his most important original production In it he aims at presenting the general method of Whitehead and Russell in a

form free from the objections raised by German critics there can be little doubt that Ramsey would have returned to this subject and further developed it He has written on 'universals' in *Mind* (Oct 1925), and on mathematical logic in the "Encyclopædia Britannica" and elsewhere Two papers in the *Economic Journal*, on the mathematics of taxation (March 1927) and of saving (December 1928) must be mentioned, on account of the high praise bestowed upon them by economists competent to judge

This scanty list reveals the bent of Ramsey's mind As a student he proved himself a mathematician of exceptional gifts, but his interest and strength lay in the application of mathematics to problems of philosophy or economics His main interest was in the very difficult boundary region between mathematics and logic in this he was already recognised as an authority For a truer appreciation of him as a man we must turn to his contemporaries, his friends and colleagues To them, Frank Ramsey seemed to tower over his fellows intellectually even as he did physically—for he stood 6 ft 3 in or thereabout and was of unusually sturdy build What Ramsey might have achieved, how grave the loss to learning in his untimely death, they cannot tell, but the memory of a friend who combined unrivalled powers of mind with an unassuming simplicity of manner and character will remain

Ramsey married in 1925, Miss Lettice Cautley Baker, and leaves two daughters At the end of November he was attacked by influenza, the ill-effects of which persisted At length an operation was judged to be inevitable, and after it he died

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We regret to announce the following deaths

Prof Charles Julin, member of the Belgian Royal Academy of Sciences and formerly professor of comparative anatomy in the University of Liège, known for his work on the morphology and embryology of the Tunicates, on Feb 5, aged seventy three years

Dr E D Roe, Jr, director of the observatory and for twenty nine years professor of mathematics at Syracuse University, known for his interest in pure mathematics, the testing of objectives and double stars, on Dec 11, aged seventy years

Prof Eduard Study, emeritus professor of mathematics in the University of Bonn, author of works on the geometry of dynamics, on ternary forms, spherical trigonometry, orthogonal substitution and elliptic functions, on Jan 6, aged sixty-seven years

Prof A V Vasiliev, of the Universities of Kazan and Leningrad, who was distinguished for his work on the theory of numbers and mathematical philosophy and was instrumental in establishing the Lobachevski prizes for works on non Euclidean geometry and mechanics, on Oct 6, aged seventy-six years

News and Views

Rationalisation, especially in reference to the chemical industry, was the subject of a paper by J Davidson Pratt, general manager of the Association of British Chemical Manufacturers, read at the University of Bristol on Feb 6 The general principle that exact knowledge should be the basis of industrial policy was most clearly stated and of course the principle is in practice recognised more generally in the chemical than in other industries Imperial Chemical Industries and the German I G are well known Chemistry involves so obviously the problem of research and co ordination of results that the tendency to large scale and long range thinking in the industries dependant upon a knowledge of chemistry can scarcely be resisted Mr Pratt was in fact preaching to the converted But the conversion, as he pointed out, has not gone far enough Besides the important issues with which he dealt there are others National 'rationalisation' on the basis of amalgamation or association of firms gives the group so united a great *political* influence, which in practice has been used for the introduction of protective tariffs and the maintenance of high prices within the tariff wall It is quite useless to say that the consumer should not suffer He will, unless policy prevents it, and the policy of a national amalgamation in any trade is never in favour of the consumer at home, unless competition is feared from abroad But even international agreements may be aimed only at keeping prices up

In Great Britain, however, we have still a long way to go towards standardisation and amalgamation in most industries before any danger to the consumer need be feared For example, the coal industry seems still to be thought of, even by its reformers, as a separable industrial unit But would not true rationalisation be based upon the *uses* of coal, not the mere getting of coal? Chemistry has scarcely been used by those who have controlled the policy of coal-getting They have provided productive industry and the private consumer with primitive lumps of a natural product and given no attention to research either for power supply or for by products If one may venture upon political issues, neither the Samuel Report nor the present Government's Coal Bill has envisaged the chemical connexions of coal The whole industry is pre scientific The chemists have still a large field to enter, outside what are called the chemical industries The danger, indicated but not emphasised by Mr Pratt, is that the financier and industrialist will not go far enough in the application of scientific knowledge and the promotion of research It is very tempting to 'rationalisers' to be satisfied with a collection of meaningless statistics as to existing processes or methods

Never before in the history of the world have greater or more momentous issues presented themselves in the political sphere than those which now confront us Even the greatest of all at any time, that of peace or war, though not now a direct or immediate issue, can never be far away but lurks as a sinister phantom in the background There is thus the greater need on the part of the electorate in any democracy for intelligent apprehension of the many difficult and intricate political problems which call so urgently for solution—and the political here neces-

sarily includes the economic The trouble hitherto has been that everyone feels himself competent to discuss and even to decide weighty matters in this field without knowledge or trained habits of thought Ignorance, shallowness, prejudice, and, above all, garrulity, reign supreme No wonder the scientific mind turns from politics in disgust, and this is a thousand pities, for, as we have frequently urged, there is plenty of scope for the scientific habit of close, concentrated, creative thought

AMID the vast mass of political writing and speaking which deafens and confounds the modern ear, one has to proceed with discriminating caution It will frequently be necessary to rule out and refuse to take too seriously the political diatribes of the daily Press, in view of the conditions under which these are produced The monthly reviews are sometimes helpful, but despite the profusion of our periodical literature, it yet seemed that there remained room for a monthly or quarterly review devoted solely to the political field, forming a platform for serious and well informed students of politics So far as one can tell from the first number of the new review, *The Political Quarterly*, published by Messrs Macmillan and Co, Ltd (price 3s 6d), and controlled by a very competent editorial board, it seems reasonable to hope that we have here a guide, counsellor, and perchance a friend, amid the thorny mazes of politics The first number is well balanced and contains several concisely written and authoritative articles, book reviews, and surveys of current affairs Alfred Zimmern's "Democracy and the Expert" should prove of considerable interest to men of science, who will also appreciate the attempts made to interpret the large amount of real experimental research and its results now undertaken in the social and political sphere The new review takes a progressive point of view and intends to act as a medium of constructive thought

SUBSTANTIAL progress is now being being made with the grid of 132,000 volt overhead wires which will ultimately connect together all the large and efficient electric stations in Great Britain Up to the end of last year, about sixty miles of the system had been completed, but before the end of this year there will be nearly a thousand miles of the system in operation The principal main line so far constructed extends from Greenock through Glasgow to Bonnybridge It includes high level crossings over the Cart and the Clyde and the extension to Dundee crosses the Forth and gives a clearance of 100 feet above high water level The problem of supplying consumers in small villages and farms has not yet been satisfactorily solved The 33,000 volt lines already in operation in several districts have given little trouble even during the exceptionally stormy weather that has occurred recently Straw blown from stacks has occasionally short-circuited the insulators, and the sea salt deposited on the line insulators near the coast has in a few instances caused them to flash over In Ayrshire the lines have been struck directly by lightning on several occasions, but beyond opening the automatic switches little difficulty has been caused It is important that children should be taught in schools the nature of conductors and insulators of electricity Possible dangers arising from high pressure conductors should also be pointed out In America there has been at least one fatality due to the wire of a kite flown by a boy nine years old coming into contact with a high pressure overhead wire A damp string in similar circumstances might conceivably be dangerous

IN a paper read to the North East Coast Institution of Engineers and Shipbuilders on Feb 7, Mr S Cook discussed the value of high pressure steam for marine work The significance of the term high pressure steam has changed with each succeeding generation of marine engineers At one time, even 15 lb or 20 lb per sq in was considered high pressure In early days, some of the foremost engineers declared against the use of high pressures, the theory not being understood Then, too, faulty construction often led to trouble To day, 200 lb per sq in may be regarded as a standard pressure at sea, though some ships are using steam at 300 lb or 400 lb per sq in pressure, while the Clyde steamer *King George V* has run successfully for three seasons with a boiler pressure of 550 lb per sq in and steam superheated to 750° F

INCREASES in thermal efficiency can be obtained by raising the pressure or temperature, and by means of tables Mr Cook set out the effect on thermal efficiency due to (1) superheat only, (2) increase of pressure only, and (3) increase of pressure and temperature From the tables it was shown "that an increase of temperature at 200 lb per sq in by superheating to 750° F increases the efficiency from 31 9 per cent for the saturated condition to 34 0 per cent for the higher initial temperature Whereas if this increase of temperature is accompanied by an increase of pressure to 1000 lb per sq in the efficiency is increased from 31 9 per cent to 39 8 per cent, a total improvement of 25 per cent, the greater part of which is due to increased pressure" In touching upon the type of boiler the quality of the feed water, the design of condensers, and other practical matters, Mr Cook made the interesting statement that, in spite of the high pressure in the *King George V*, in three and a half years it had not been found necessary to remake a single main steam pipe joint

THE issue of the *Journal of the Society of Chemical Industry* for Jan 24 contains an interesting illustrated article by Sir Robert Hadfield, T G Elliott, and R J Sargant on recent developments in corrosion and heat resisting steels They give a good historical account of the development of stainless chromium steel, in which the work in France from 1876 onwards, the discovery by Brearley in Sheffield in 1912 and after that this steel could be hardened, tempered, and polished for use in making stainless cutlery, and other investigations are reviewed Sir Robert then points out that his firm is now collaborating with the Fourchambault Co in France and the Midvale Steel Co of Nicetown, Pa, in the development of a series of heat-resisting steels These are of two types, those which are hardened by quenching and those which are softened In the former, chromium is practically

the only alloying element, and by varying the amount of carbon the steel may be made to range from a soft material suitable for stamping into dishes and pans to a hard steel suitable for knife blades The best corrosion resistance is obtained with somewhat higher chromium percentages, namely, 17 18, than the 12 5 14 formerly used A steel with 17 per cent or more of chromium and 7 per cent or more of nickel is not hardened by quenching and has superior corrosion resistance, although it is more expensive The article gives many details of the structures, resistance to acids, etc, of these steels, and also of their industrial applications, including furnaces and operations involving high temperatures and pressures

A PROPOSAL to excavate the Roman city of Verulamium was considered at a meeting of the St Albans City Council on Feb 4, when the Parks Committee presented a report which had been made by Dr R E Mortimer Wheeler on behalf of the Society of Antiquaries at the request of the Mayor The report stressed the importance of Verulamium, first as one of the great tribal capitals of prehistoric Britain, and secondly as one of the great centres of Roman Britain, which grew up as a city of the first rank a century or more before London was even founded It appears to be the only city in Roman Britain which attained the rank of a *municipium* Dr Wheeler suggests that the examination and consolidation of the better preserved stretches of the Roman defences should be given precedence These defences consist of a magnificent ditch, unequalled in Britain, a level platform or berm, behind this a wall of flint rubble with bonding courses of brick, and a broad and high bank piled against the inner side of the wall The wall is at present in some danger from the weather and the disintegrating action of ivy and tree roots When the defences have received attention, it is suggested that the plan of the town should be revealed and the principal buildings located The Council decided to appoint a committee for this work to which the Society of Antiquaries and the St Albans and Hertfordshire Archæological Society would be invited to appoint representative members

A PAPER was read on Jan 27 by Prof R A S Macalister and Prof J K Charlesworth before the Royal Irish Academy dealing with the archæological finds at Rosses Point, Sligo The announcement of the discovery of these implements was first made by Mr J E P Burchell in NATURE of Aug 20, 1927, p 260 An energetic discussion followed, during which directly opposing views were expressed, even by archæologists who accepted the human origin of the implements The geological evidence is almost unanimously opposed to the possibility of palæolithic implements being found in this particular part of Ireland Profs Macalister and Charlesworth expressed the opinion that until archæologists can reconcile their own differences, and find some means of squaring their conclusions with those of geologists, there is nothing to be gained for science from these implements

SIR DOUGLAS MAWSON'S Antarctic expedition has returned to Kerguelen to coal the *Discovery* It is now too late in the season to allow further exploration within the area of pack ice Reports to the *Times* summarise the season's work The edge of the land has been outlined between long 44° E and 66° E, including Enderby, Kemp, and MacRobertson Lands Farther east as far as 90° E the position of the continental margin has been indicated by soundings Much of the new coast line is fringed by ice cliffs The ice sheet is pierced by many rocky nunataks, and several definite mountain ranges have been charted, of which the principal is Scott Range in Enderby Land It has about 200 peaks, occasionally rising to 7000 feet, and some of these have been fixed From the rock collections on the coast, islets, and from the dredge there is every indication that this part of Antarctica is built of ancient crystalline and early sedimentary rocks Much oceanographical work has been done with the sonic sounder and deep sea water bottle This is probably more detailed than any previous expedition has been able to do High level meteorological observations show that at 5000 ft the principal air currents are from the north west to south east The strong gales off Enderby Land are from the east or north of east, and not from the south east as they are in Adelie Land and elsewhere on the plateau coast The pack ice is thus driven to the west or south of west, and the coasts of Enderby and Kemp Lands are kept comparatively clear except for the impediment offered by great rows of bergs, from farther east, stranded in the shallow water of the continental shelf East of Kemp Land there is much pack, reminiscent of the heavy ice of the Weddell Sea

A SHOWER of fishes from the sky might be reckoned one of the classic stories of anglers, were it not that abundant evidence exists of this natural phenomenon Dr E W Gudger, who on two previous occasions has recorded the results of his investigation of falling fish records, returns to the subject in the December *Scientific Monthly* In all, he has found about seventy one accounts, more or less well authenticated, of rains of fishes extending from A D 300 up to the present time, and in space encircling the whole globe He adds one or two new records in May 1900, at Rhode Island, when boys gathered and sold fishes by the pailful, and in May 1928, when hundreds of small fishes were deposited on a newly planted cotton plot at Tarboro, in North Carolina Of course, the explanation of the fish rain is the same in every case High winds, particularly whirlwinds, pick up water, fishes and all and carry them inland, and when the velocity of the air and clouds becomes relatively lowered, the fishes fall to earth

IN view of the serious aspect which the slaughter of whales for commercial purposes has assumed, it is significant that the economic extinction of whales falls to be recorded from a new area For the second time in history there are no longer sufficient whales along the Californian coast to support a whaling industry (*California Fish and Game*, p 337, Oct. 1929) In 1865 there were eleven whaling stations on the coast

of California, and a considerable fleet of ships was employed in the industry Writers often mentioned seeing fifteen whales at one time in one place, and in 1853 it was estimated that fully 30,000 Californian grey whales visited the California coast annually By 1880 the decline in whaling was noticeable, by 1890 practically no whaling was possible along the coast Then in 1919 with the gun harpoon and speedy ships with a hundred mile radius, commercial whaling again began in Monterey Bay In the new operations, as was to be expected, only four or five California grey whales were killed, but 781 hump backs were secured within three years Now the hump backs also have been reduced below the economic level In less than ten years of operation, the Moss Landing whaling station has been dismantled and operations abandoned because of lack of whales It is a fortunate thing that demand is not sufficient to endanger still more the surviving breeding stock No laws have been enacted in California to curtail the catch or otherwise to protect whales

In his Friday evening discourse on "Diving" delivered at the Royal Institution on Feb 7, Prof Leonard Hill showed and described the new sub marine escape dress which has recently been tested by the Admiralty He also showed a new self con tained diving dress with an injector for circulating the air in the helmet through soda lime and worked by the feed from a cylinder of oxygen and air With this dress the diver is independent of hose pipe and can detach and fix his life line containing telephone wires, and proceed with a distance line into a wreck The danger of oxygen poisoning has to be met by suitable concentration of oxygen in the air supply, and fixed periods of work at various depths The decompression of divers by the new submersible decom pression chamber of Mr R H Davis was dealt with and the use of oxygen for washing nitrogen out of the body, so halving the present times for decompression, was discussed Speaking of the danger of oxygen poisoning, Prof Hill suggested that air containing only 10 per cent or even 5 per cent of oxygen should be used for deep work at say 300 ft, the diver enriching the air he breathes with oxygen while climbing up, and then breathing pure oxygen on entering, at 66 ft, the submersible decompression chamber and while being decompressed in that chamber By such means diving at 300 ft or even 350 ft can be made safe

Mr Reijiro Wakatsuki, the chief Japanese dele gate to the Naval Conference, spoke to the people of Japan on Feb 9 by Marconi beam telephony from the Imperial and International Communications Marconi Beam station at Dorchester, his speech being relayed throughout Japan by means of the Japanese Broad casting Company's stations The wireless telephony apparatus designed by the Marconi Company was con nected to the beam telegraph aerial used for tele graphy with Japan, and reports received indicate that the transmission over the great distance separating the transmitting and receiving stations was very satis factory The incident is noteworthy because it was only six years ago that Marconi first transmitted in telligible speech to Australia, and the evolution of the system of combined telegraphy and telephony on the beam aerials marks the progress which has been made in transmission over long transcontinental distances

It is announced by the Hague correspondent of the *Times* that on Feb 10, M Reimer, Minister for Dykes and Waterways in Holland, opened the first pumping stations for the draining of the Wieringen Polder, the first of the polders to be completed in the scheme for the reclamation of the Zuider Zee One station is at Den Oever at the north, and the other at Medemblyk at the south of the polder, and about eight months will be required to free the polder of water The project for the enclosure of the Zuider Zee was described in an article in Nature of Sept 21, 1929, by Dr Brysson Cunningham The Wieringen or North west Polder, with an area of about 50,000 acres, is the smallest of the four polders contemplated When the whole of the reclamation work is completed, it is estimated that more than half a million acres, or about 10 per cent of its present area of arable land, will be added to Holland The enclosed area will not, of course, be immediately available, it is considered that six or seven years must elapse before it reaches its full cultivable value

Various agencies tend to an improvement of the condition of urban atmospheres None can be more welcome than the action of the Royal Institution of British Architects in issuing a report on smoke abatement (price 1s) The widespread damage to buildings has convinced the architects of the need, and they have much—sometimes all—of the responsibility for choosing the appliances for consuming fuel in domestic and other buildings There can be little doubt that if architects as a body strive to prevent the introduction of smoky appliances into buildings, considerable amelioration should in time follow The report gives an account of the law as to atmospheric pollution Technical information as to the effects of smoke and sulphurous impurities on buildings is given, and recommendation as to the choice of fuel and heating systems Little exception can be taken to the technical contents but here and there appear signs that no one on the Committee had first hand knowledge of fuels Still, the report is for architects, not fuel experts

The fourth annual report for 1929 of the Pharma cological Laboratories of the Pharmaceutical Society of Great Britain indicates that the time of the staff was divided between research work and the examina tion of samples submitted by manufacturers Some of the problems investigated were suggested by the revision of the "British Pharmacopœia" The director, Dr Burn, working with Prof Bijlsma and Dr Gaddum, has found that the oxytoxic value of a pituitary (posterior lobe) extract does not necessarily indicate its pressor or antidiuretic activity each property must be assayed separately The pressor principle has antidiuretic activity and also inhibits the fall of blood sugar produced by insulin Exam ination of samples of strophanthin by Mr Wokes

indicated that the average activity was only 60 ± 15 per cent of the international standard ouabain the strength of commercial tinctures of strophanthus was found by Dr Burn to be about equal to a 0 42 per cent solution of the standard ouabain, the majority lying between 0 31 and 0 53 per cent Dr Barba Gosè has investigated the toxicity of samples of tetraiodophenolphthalein, the determinations being carried out by intravenous injection into the tail vein of mice the criterion used was the death of half the animals within three days The toxicity was found to vary from 0 27 mgm to 0 37 mgm per gm mouse Dr Coward, who is in charge of the nutrition department, has carried out a number of investigations on different vitamins With Key and Morgan she has obtained evidence of a new growth factor for the rat, which is found in certain samples of casein, in fresh milk, lettuce, fresh and dried grass, beef, liver and wheat embryo, but is absent from dried yeast and butter Its presence is essential in the synthetic diets used for assay of vitamins A or B Dr Coward has also found that cod liver oil contains from 50 to 150 units of vitamin D per gm , butter 0 8 1 0 unit per gm , milk 0 2 unit per gm as a maximum, and irradiated milk from 0 1 to 2 0 units per gm The staff of the Laboratory, together with attached workers, published seventeen papers during the year

AMONG the contributions contained within Vol 11 of *Nauka Polska*, 1929 (*Science and Letters in Poland*, an annual publication edited by Prof S Michalski) mention may be made of Prof Paul Rybicki's communication on " Learning in Relation to Social Life , Some Borderline Problems of Sociology and the Theory of Learning " and that by Prof S Ciechanowski, which gives an account of the position and needs of medical science in Poland The former article contains a close study of the subject, such as might be expected from so thoughtful a scientific worker as Prof Rybicki, whilst the latter is especially significant since it was only last spring that an important medical congress was held in Warsaw The considered views which Prof Ciechanowski now publishes indicate the lines upon which he believes Polish medical science should advance In this volume, too, Dr M Loret announces the results he has obtained from some searches into ancient archives for information concerning the Polish scholars in Italy and at Rome during the sixteenth, seventeenth, and eighteenth centuries A survey of scientific thought abroad is also included in *Nauka Polska*, and it is interesting to note that lectures recently delivered by Prof R A Millikan (" Science and Society "), Sir James Ewing (" A Century of Inventions ", NATURE, **121**, 947 , 1928) and Prof J F Thorpe (" Co operation in Science and Industry ", NATURE, **123**, 531 , 1929) have been considered of such importance that they are now made available for Polish students Mention is made also of the formation of the Parliamentary Science Committee in Great Britain last year Finally, there is a lengthy survey of recent acts and regulations issued by Polish legislative bodies and higher education authorities and an account of the purely educational and scientific (especially biological) aspects of the exhibition held last year at Poznan

IN connexion with the anniversary of Galen's birth (A D 130) a small exhibition has been prepared at the Welcome Historical Medical Museum, 54 Wigmore Street, W 1

PROF G VON HEVESY, of Freiburg im Breisgau, will deliver the Hugo Muller Lecture of the Chemical Society on Wednesday, Mar 26 The title of the lecture will be " The Chemistry and Geochemistry of the Titanium Group "

DR W H MILLS, University lecturer in organic chemistry in the University of Cambridge, has been awarded the Longstaff Medal for 1930 of the Chemical Society for his distinguished researches in organic chemistry, especially in its relation to stereochemistry The presentation of the medal will be made at the annual general meeting on Mar 27

SURGEON CAPTAIN SHELDON FRANCIS DUDLEY has been awarded the Chadwick Gold Medal and Naval Prize of £100 for his medical and sanitary work and scientific researches during the past five years and before, directed to the prevention of disease among men of the Royal Navy The clause of the Chadwick Trust Scheme under which the award is made permits the presentation of a similar prize and medal once in every five years to a medical officer of the Navy, Army, or Air Force who, in the opinion of the Medical Director General of his arm of the service, shall have in the preceding five years specially assisted in promoting the health of the men of the force to which he is attached

THE Essex Field Club will celebrate its fiftieth anniversary on Saturday, Feb 22, when a special commemoration meeting will be held in the Great Hall of the West Ham Municipal College, at which a number of distinguished scientific workers and others interested in the Club will be present The president of the Club, Mr D J Scourfield, and the Mayor of West Ham will hold a joint reception at three o'clock in the afternoon, and speeches will be made by the Countess of Warwick, the Lord Lieutenant of Essex, the Chairman of the Essex County Council, Sir Henry Miers, Sir A Smith Woodward, and Sir David Prain An evening conversazione will follow, when a special exhibition of natural history and microscopical objects and of topographical photographs and prints of Essex will be made, and lantern lectures will be given by Mr W E Glegg and Mr S Hazzledine Warren The Club's Museum, which adjoins the College, will be closed to the general public, and will be available for inspection by guests on the occasion

WE have received Part 4 of Vol 3 of the *Peking Society of Natural History Bulletin* (June 1929, Peping The China Booksellers 1 50 dollars) It contains six scientific articles, of which no less than four are written by Chinese university graduates The subjects treated include the reproductive system of a Chinese Katydid, the anatomy of water snails, and the taxonomic characters of dragonflies and

Cyclops, all of which are illustrated by black and white plates The Society is to be congratulated on being able to issue this well printed journal, which is destined to become the medium for making known zoological discoveries in China

THE latest catalogue (No 340) of Messrs W Heffer and Sons, Ltd, Petty Cury, Cambridge, gives the titles of nearly 3000 volumes dealing with mathematics, physics, astronomy, chemistry, metallurgy, anthropology, ethnology botany, agriculture, geology, geography, medicine, physiology, zoology, and biology It also contains a lengthy list of portraits of men of science

APPLICATIONS are invited for the following appointments, on or before the dates mentioned — A senior lecturer in science at the Notts County Technical College and School of Art, Newark—The Principal, County Technical College and School of Art, Newark (Feb 17) A bacteriologist and pathologist under the County Borough of Belfast and Belfast Port Sanitary Authority—The Town Clerk, Belfast (Feb 21) A technical assistant under the Directorate of Ordnance Factories of the War Office—The Permanent Under Secretary of State for War (C 4), War Office, Whitehall, S W 1 (Feb 22) Temporary assistant chemists at the Government Laboratory—The Government Chemist, Clement's Inn Passage, W C 2 (Feb 22) A demonstrator in the Division of Bacteriology and Immunology of the London School of Hygiene and Tropical Medicine—The Secretary of the London School of Hygiene and Tropical Medicine, Keppel Street, W C 1 (Feb 24) A lecturer in physics at Chelsea Polytechnic—The Principal Chelsea Polytechnic, Manresa Road, S W 3 (Feb 25) A scientific assistant under the Board of Greenkeeping Research —The Director of Research, St Ives Research Station, Bingley, Yorks (Feb 28) Two junior technical officers in the Admiralty Technical Pool for an Admiralty Experimental Establishment, mainly for work in connexion with acoustical and electrical apparatus—The Secretary of the Admiralty (C E Branch), Whitehall, S W 1 (Feb 28) An assistant dairy bacteriologist in the Department of Agriculture and Horticulture of the University of Bristol—The Registrar, The University, Bristol (Mar 1) A scientific research officer in the Irrigation Branch of the Punjab Public Works Department—The Secretary to the High Commissioner for India General Department, 42 Grosvenor Gardens, S W 1 (Mar 31) A farm manager and lecturer in animal husbandry and a stockman and dairy instructor at the Arab Agricultural School, Tulkarem, Palestine—The Private Secretary (Appointments), Colonial Office 2 Richmond Terrace, Whitehall, S W 1 (Mar 31) A professor of physics at East London College—The Academic Registrar, University of London, South Kensington, S W 7 (April 8) A professor of geography at Birkbeck College—The Academic Registrar, University of London, South Kensington, S W 7 (April 10) A lecturer in petroleum production, in the Department of Oil Engineering and Refining of the University of Birmingham—The Secretary, The University, Birmingham (April 16) A reader in physics in the University of Dacca, East Bengal, India—The Registrar, the University of Dacca, East Bengal, India (April 30)

Our Astronomical Column

Prediction of the Sunspot Curve - Prof Dinsmore Alter gave an address at the meeting on Jan 1 of the British Astronomical Association, in which he described researches on the effects of the different planets on sunspot activity The method adopted was that described by Prof E Brown in vol 69 of *Mon Not Roy Ast Soc* Prof Brown noted that the sunspot period was not very different from the period of Jupiter, he found that by combining the tidal influences of Jupiter and Saturn he could get a curve that followed that of the observed sunspot activity very closely His prediction of a late maximum in 1907 was fulfilled, since then the curve has been carried on to 1955, and its agreement up to date with the observed curve is fairly close, though the 1917 maximum is predicted too early Later, the inner planets were introduced, since tidal action varies as the inverse cube, this partially compensates for their smaller masses, the fact of the tidal influence being appreciable is explained by the approximate equilibrium between gravitation and light pressure at the sun's surface

Observers' Handbook —This annual, issued by the Royal Astronomical Society of Canada, is edited by Prof C A Chant, and contains this year a useful catalogue of stars down to magnitude 3 5 It gives magnitude, both apparent and absolute, proper motion, parallax, distance in light years and radial velocity There is a similar list for stars within 5 parsecs of the sun the latter list has been steadily growing, and now contains 35 stars, of which only four exceed the sun in luminosity The one of smallest luminosity is Wolf 359, the absolute magnitude of which is 16 5, implying that its luminosity is one fifty thousandth part of the sun's In the list of satellites the name 'Triton' is inserted for Neptune's satellite This very suitable name was suggested by the late M Camille Flammarion, and is now adopted by many astronomers

The Constant of Aberration —The fact that aberration has an annual period introduces the difficulty of eliminating seasonal effects, due to temperature or other meteorological causes, from measures made for its determination Mr H R Morgan contributes a paper to *Astr Jour* No 933, in which he deduces a value for the aberration constant from observations in declination of stars near the pole made with the 9 inch transit circle at the U S Naval Observatory, Washington, between 1903 and 1925, as the stars were observed at both upper and lower culmination, the observations being made near the beginning and end of the night (at which times the aberration is almost wholly in declination), and each star was observed twice in the year at intervals of 6 months, reasons are given for believing that seasonal terms have been nearly eliminated This conclusion is supported by the fact that different groups of stars give accordant results The value adopted for the constant is $20\ 479'' \pm 0\ 008''$ Using Michelson's latest value for the velocity of light, the corresponding distance of the sun is 92,895,300 miles, and its parallax is $8\ 800'' \pm 0\ 003''$

Research Items.

Migration of Birds and Sex Cycles—By a series of experiments on the junco (*Junco hiemalis connectens*) Prof William Rowan has shown that the rhythm of the reproductive organs can be interrupted almost at will by appropriate lighting conditions (*Proc Boston Soc Nat Hist*, vol 39, No 5, 1929) He has thus succeeded in arresting the normal spring recrudescence of the gonads, in causing premature recrudescence in mid winter, and by alternate over and under lighting causing a maximum recrudescence three times and a minimum reduction twice in the course of a normal single cycle of a year Further, even in the absence of light, increasing periods of compulsory exercise cause a recrudescence of the gonads It is suggested, therefore, that the increase of light permits increased exercise and that this is the crucial factor in inducing the development of the gonads Birds which were released while the sex organs were in process of increasing or dwindling migrated, while those set free at the state of maximum or minimum development showed no inclination to move away Rowan shows that the spring recrudescence of the sex organs cannot be due to rising temperatures, or the autumnal retrogression to falling temperatures, as has been supposed While these conclusions apply primarily to the junco, he sees no reason to believe that it is exceptional

Breeding Habits of South African Frogs and Toads—Three papers in the *Annals of the Transvaal Museum* (vol 13, No 3, 1929) describe the breeding habits and the early development of several species of frogs and toads found in the neighbourhood of Stellenbosch The appearance of temporary puddles and full drainage furrows following the winter rains is the signal for spawning The distribution of the spawn shows a certain selectivity of pool conditions on the part of the spawners, and a case of mass spawning illustrated differential survival In a temporary pool two species of *Rana*, one of *Cacosternum* and one of *Bufo*, spawned one morning and the young hatched, but on the examination of the larvæ when the pool had eventually dwindled to a square foot in area, only examples of *Rana greyi* were found C G S de Villiers describes the food of the different tadpoles, their characteristics and development, and gives hints for keeping alive and preserving examples for subsequent examination He warns collectors against preserving amphibian larvæ in alcohol, which invariably results in shrinkage of the tissues and serious distortion Where field conditions make the narcotising of the larvæ and preservation in a fixative containing sublimate impossible, formalin or carbolic acid is recommended It would have been convenient had titles been attached to the figures and had a short summary followed the longest paper V Fitzsimons and G van Dam give for the first time an account of the breeding of *Breviceps*

Californian Salmon—In a paper on the Sacramento San Joaquin salmon (*Oncorhynchus tschawytscha*) fishery of California, Mr G H Clark (Division of Fish and Game of California, *Fish Bulletin* No 17) gives a review of the history of this fishery A serious decline set in after 1918, and in 1926 and 1927 the commercial catches were lower than they had been in any year since 1874 This is attributed to a depletion brought about chiefly by over fishing, for which ocean trolling is most responsible, and by dams obstructing streams and cutting off spawning grounds The author includes in his report a survey of the spawning grounds of the Sacramento and San Joaquin river systems and some information on the life history of the salmon It is noted that ocean trolling accounts for the taking of numbers of immature fish as well as mature, and the biological work aimed at ascertaining the age of maturity of the salmon and the percentage of age classes which mature in a given year It was found that 50 per cent of the fish mature at four years of age, the five year and three-year fish following in order of abundance It is thought that 70 90 per cent of the young salmon go to the sea during their first year

Pelagic Polychætes of the *Terra Nova* Expedition—The Report on "The Pelagic Polychæta" of the British Antarctic (*Terra Nova*) Expedition, 1910 (Natural History Report Zoology Vol 7, No 3, British Museum (Natural History), 1929), by Dr William B Benham, includes eleven species belonging to three families Of these the Alciopinæ are the most important, two new species, both from New Zealand only, being described These are *Vanadis augeneri* and *Callizona grayieri* The widely distributed *Alciopa cantrainii* and *Torrea candida* are now shown to occur in the waters round the northern coasts of New Zealand The Alciopinæ may be regarded as Phyllodocines which are modified for a pelagic life and are here placed in the sub family Alciopinæ belonging to the family Phyllodocidæ Of the four species of *Tomopteris*, most is said about the Antarctic *Tomopteris carpenteri* and there is a long discussion as to whether this species possesses a 'tail' Apparently it has none, and the tomopterid from South Africa recently described by M'Intosh as *T carpenteri*, which has a 'tail', seems to be a different species

Elm Disease—The so called Dutch elm disease is so insidious in its spread that any research which throws light on this subject is of great economic importance J G Betrem (*Meded Laborat Entomol Landbouwhoogeschool*, Wageningen, Holland) has published a paper in Dutch, with a German summary, in which he considers it proved that the disease is spread by the elm beetle (*Scolytus scolytus*) In a series of experiments he showed that when beetles are shaken up with distilled water and the water is plated out on nutrient agar, the fungus, *Graphium Ulmi*, now usually considered to be the cause of the disease, dominates the resultant growths Further, beetles allowed to run over sterile nutrient agar caused much infection by *Graphium Ulmi*, and finally, when the intestines of beetles were removed and inoculated into agar, they gave rise to the fungus almost exclusively

Afforestation in South Africa—South Africa is about the only Dominion of the Empire with but a small area of indigenous forest extant A great deal of attention has therefore been concentrated of late years on afforestation work, mainly with exotics Dr H M Steven's paper, entitled "Afforestation in South Africa", in the second issue of vol 3 of *Forestry*, makes it evident that a great deal of high class work has been undertaken and a considerable experience gained in all the branches which such operations entail Experience has to be bought by 'trial and error' and careful research Many problems remain to be answered, but the paper gives evidence that the forestry authorities are on the high road to solving certain questions as to the species which will offer the best hope of success whilst at the same time providing the Dominion with an increasing amount of the types of timber hitherto imported

Falcon Island a Pyroclastic Cone—The December, 1929, number of the *Amer Jour Sci* contains an

interesting study of Falcon Island, an active Tongan volcano, by J E Hoffmeister, H S Ladd, and H L Alling The island is described as a typical South Sea island in the making It is a pyroclastic cone built by explosive eruptions Not a single lava flow has been found on the island, but the pyroclasts, which are mainly of dark brown glass, contain labradorite and pyroxene and are clearly of basaltic type Many islands of the south west Pacific have been built up in this way from the Eocene onwards There is here no evidence that pyroclastic action marks the waning stages of vulcanism Eua, near Falcon, has a core of volcanic tuff which is over lain by Eocene limestone White Island, near New Zealand, is a modern representative Such conditions do not exist in the Hawaiian Islands of the north Pacific The present Falcon Island is considered to be an example of the first stage of island formation in the South Seas The second stage is the reduction of the mound of ash and scoria to a shoal or sub marine bank Upon this, organic deposits then accumulate and an atoll may ultimately be produced A fourth stage is recognised when uplift of the limestone capped bank takes place, Eua being an example Falcon Island lies on the well marked fault line which stretches from Samoa to New Zealand, a line on which many volcanoes, active or dormant, are situated

Chemical Denudation —In a report on *Den Kemiska Denudationen i Sverige* (with a summary in French), J V Eriksson presents the results obtained during the period 1909-25 by the Swedish Bureau of Hydro graphy and the National Service of Meteorology and Hydrography in the course of a detailed study of the transport by Swedish rivers of materials in suspension and solution (*Medd f Statens Meteorologisk Hydro grafiska Anstalt*, Bd 5, No 3, pp, 96, Stockholm 1929) Work was carried out at 69 stations and 11,313 analyses were made The final results are given in metric tons of material removed per year from each sq km of the areas investigated, the latter covering 57 per cent of the whole country It is noted that it would be unsafe to assume that the total for the whole country could be obtained from the ratio 57 100, since the terrains not yet studied are mainly coastal or argillaceous In a series of excellent maps, the geographical distribution of the re sults is presented graphically for inorganic materials organic materials, CaO, Cl, and SO_3 Annual and seasonal variations are well brought out by tables of comparative figures In dominantly calcareous regions chemical denudation removes 60 to 70 tons/km ^{2}/year, whereas in forested areas the figure is generally about 10 tons Comparison with results for other countries (Europe, North America, and the Nile) shows that in recently glaciated lands chemical de nudation makes up 80 to 90 per cent of the total, whereas corresponding percentages are for the Mississippi 13 to 46, for the Rhone 19 to 66, with an average of 23, for the Blue Nile 17, and the White Nile 72 It is concluded that in Sweden chemical denudation amounts to 70 to 90 per cent of the total

Isotopes of Nitrogen —The recent discovery of oxygen isotopes of atomic masses 17 and 18, and of a carbon isotope of mass 13 (see NATURE, Mar 2 and June 1, 1929, vol 123, pp 318 and 831, and Aug 3, 1929, vol 124, p 182) has now been followed up by the announcement by S M Naudé in the first number of the *Physical Review* for December of the discovery of an isotope of nitrogen of mass 15 If this existed, it should produce some additional band heads near 2156 A in the spectrum of nitric oxide, and a search for these indicated that they were actually present, very close to the predicted positions The bands were examined in absorption, and the possibility that the reputed isotope effect was due to the presence of molecules such as $(NO)_2$ ruled out by the fact that the relative intensity of the various band heads was independent of the pressure of the nitric oxide Nitric oxide $N^{15}O^{16}$ is about as abundant as nitric oxide $N^{14}O^{18}$ Some very faint absorption lines have also been observed which agree with those calculated for the molecule $N^{16}O^{16}$, but the existence of this third isotope, of atomic mass 16, must still be regarded as uncertain

An Ammeter for High Frequency Currents —The problem of measuring alternating currents of very high frequency has come rapidly to the front during recent years owing to the extensive use of radio communica tion In the early days of electric supply, power engin eers sometimes thought that possibly there were large losses in their mains owing to the so called 'skin effect' This effect caused an uneven flow of current across the section of the main, the current density as a rule being greatest near the surface One of the advantages of concentric mains in the old days was supposed to be that they largely diminished this loss It is only, how even, when the mains are very large that this loss be comes notable at the standard power frequency of 50 When frequencies of 100 million are used as in radio work, the skin effect becomes enormous, and many attempts have been made to obviate the difficulties it causes At this high frequency an ordinary ammeter would, owing to its inductance allow practically no current to flow in the circuit In a paper read to the Institution of Electrical Engineers on Feb 5, Prof C L Fortescue described an ammeter he has invented which practically overcomes all the difficulties hitherto experienced He points out that these difficulties arise from three main causes That the capacity effects make the current in the instrument different from the current outside, secondly, even very short conductors have a high inductive reactance at high frequencies, and thirdly, the presence of the measuring device in the circuit changes the value of the current that has to be measured He gets over the difficulty by using a thin wire screened by and coaxial with a concentric cylinder The instrument is calibrated with direct current, and he shows how the true current can easily be calculated by theory

Laboratory Hot-Water Ovens —We have received from Messrs Brown and Sons, Ltd, 9 Wedmore Street, Holloway, N 19, an illustrated booklet which contains particulars of the patent 'Sanbro' laboratory hot water ovens By means of a very simple device the boiler at the base of the oven can be removed, cleaned, and replaced within a few minutes and without the use of special tools Moreover, when the deposit in the boiler becomes excessive, the latter can be replaced by a new one at a small cost The boiler consists of a loose pan to the inside of the top rim of which is fixed a gutter into which the oven proper fits The two parts when fitted together form the steam chamber, an air tight connexion being pro duced merely by a layer of water which forms an effective seal The ovens, which have already been installed in many laboratories with satisfactory results, can also be combined with water stills The great advantage of this new device will be at once apparent to anyone who has had to incur the cost of repairs to oven stills of the older type, in which hard water has been continuously used The device can be fitted without much trouble to existing ovens of the sealed up type and can be adapted to various kinds of heating supply

Chemical Warfare

DR HERBERT LEVINSTEIN, in a lecture delivered on Feb 3 before the London section of the Society of Chemical Industry, courageously examined the position of chemical disarmament and chemical warfare in relation to the ideals and foundations of future peace and to the stern realities of the dangers of conflict Whilst it is probably true that man is by nature a peaceable creature, and hence amenable to the settlement of domestic disputes peaceably under compulsion of law, the extension of the same principle to international disputes, however devoutly to be sought, is not so simple as may appear The necessities of life are provided for the individual who falls in the social struggle but not for the nation which succumbs in society organised on competitive principles, and the possibility of defensive resort to arms remains in the background of international agreements Hence with the present organisation of society the possibility of fighting is never remote, and Dr Levinstein's first plea was for the strengthening of the efforts of the League of Nations in making wars on a large scale less probable

In international disputes, arms are the last resort, other means of persuasion are equally available, and not the least powerful is the possession of a powerful chemical industry Restriction of naval armaments, largely an economic measure, by making war cheaper tends in a sense to make it easier, and in Dr Levinstein's opinion increases the importance of the chemical arm Examination of the text of the agreements relating to the prohibition of chemical warfare leads to the conclusion that the prohibition is largely ineffective He finds, for example, no prohibition of the use of screening smokes, yet it may be argued that such smokes as that of chlorosulphonic acid are in concentrated form deleterious to the human organism and are therefore forbidden Justification of the use of a smoke can be based on the grounds that its toxic properties are accidental, as indeed are those of the fumes from high explosive shells Tear gases, used in the United States for the protection of banks and safe deposits and for dealing with riots and civil disturbances, may be classed as non asphyxiating and non poisonous, since in low concentration they affect the eyes alone

Chemical warfare has not, said Dr Levinstein, been justly condemned by the general opinion of the world, condemnation lies against its use by the Germans in 1915 in violation of the spirit, if not of the letter, of the Hague Convention, and because it was used against unprotected troops He asked why preference should be shown for the use of high explosives with their ghastly effects, there is, unfortunately, no prohibition against the dropping of high explosive shells or incendiary bombs from hostile aircraft at dead of night on crowded cities

The object of war is not to destroy human life, but to break down the opponent's will to resist Gas, Dr Levinstein claimed, maims or kills a far smaller proportion of those whom it puts out of action than does any other weapon used in the recent War, thus in proportion to the military results it causes far less human suffering, and, in addition, less of the wasteful destruction of the work of man Dr Levinstein quoted statistics showing that of the casualties caused by gas only 2 3 per cent died and few—about 0 5 per cent—were permanently injured, whilst of casualties resulting from all other forms of warfare 25 33 per cent died, and of the survivors 2 5 per cent were maimed, blinded, or disfigured for life He did not suggest that gas warfare is anything but dreadful, but he argued that it is both less dreadful and of greater military value than the older forms of warfare It causes inconvenience, holds the element of surprise, permits economy of force, and is equally serviceable in attack and defence

In Dr Levinstein's opinion it is an elementary act of prudence for a nation situated as is Britain to see that research for chemical warfare purposes should continue to be a subject for special study, and that funds for that purpose should not be reduced below the safety point Guns and shells can be restricted, and in any case take long to prepare, but gas can be projected from quickly improvised containers, limitation of armaments as proposed may therefore greatly increase the military importance of the chemical weapon, and prudence dictates contact in peace time between military authorities and the chemical industries

If a purely general observation supplementing Dr Levinstein's remarks may be offered, it is simply that modern warfare in all its forms is increasingly based on chemical knowledge, and that if chemical research can make warfare even a little less probable and less hideous, its potentialities in that direction deserve the attentive interest and unbiassed support of all right minded men and women

Variations in the Skeletal Structure of the Pig

HAVING observed marked variations in the lengths of exhibition carcases of swine used for bacon curing, Prof A M Shaw, of the University of Saskatchewan, suspected that the difference might be due to variations in the numbers of ribs He accordingly counted them and found that, of nine carcases exhibited, two possessed 16 pairs of fully developed ribs, four possessed 15 pairs, while the remaining three carcases possessed 14 pairs of fully developed ribs each

Reference to standard works on veterinary anatomy was made Sisson states "The ribs number fourteen or fifteen pairs The fifteenth rib when present may be fully developed and its cartilage enter into the formation of the costal arch, but in most cases it is only about an inch (2 3 cm) in length" The vertebral formula given by Sisson is *C* 7, *T* 14 15, *L* 6 7, *S* 4, *Cy* 20 23 He also states that "the occurrence of fifteen thoracic vertebræ is quite common and the existence of sixteen or even seventeen has been recorded Reduction to thirteen is very rare" Various model pig skeletons examined by Shaw all possessed what was apparently considered to be the normal number, namely, 14 pairs

Prof Shaw has had careful counts made in Canada, the United States, Great Britain, and Denmark, and has now published the figures for 3957 animals, representing several breeds, grades, and crosses (*Scient Agric*, **10**, 1, September 1929) When summarised they show the following results 13 pairs of ribs, 20 pigs, 14 pairs, 1574 pigs, 15 pairs, 1829 pigs, 16 pairs, 310 pigs, 17 pairs, 7 pigs The remainder showed uneven pairs or floaters More than 400 vertebral columns were scraped and cleaned for identification, varying in number of ribs from 13 to 17 The counts showed that cervical (7) and sacral (4) remained constant, thoracic varied according to the number of ribs, while the lumbar variation is from 6 to 7, except in two cases, where there were only 5 present The true ribs were always attached to

thoracic vertebræ and the increase in lumbar vertebræ were associated with the smaller number of ribs present and vice versa There appeared to be no relationship between sex and the number of ribs Very interesting observations were made in regard to litter mates in that "no normal litters were found where all pigs possessed the same rib number"

In addition to the scientific value of these observations, the economic aspect of rib variation in pigs is of considerable importance from the point of view of bacon, since the increased length of the carcase is mainly in that region usually regarded as furnishing the prime cuts The awards in various competitions supports this, even though the judges apparently had no thought of rib count Moreover, in a private communication Prof Shaw states "there seems to be ample evidence that the animals with fifteen and sixteen pairs of ribs are decidedly superior from the standpoint of rate of growth and economy of gains to those possessing thirteen or fourteen pairs"

The Sugar Industry

THE world's sugar industry was the subject of the Streatfeild Memorial Lecture delivered at the Institute of Chemistry by Mr Lewis Eynon, on Nov 22, 1929, and recently published Sugar cane, which until about 130 years ago, was the only source of sugar, was known before the Christian era, and is supposed to have originated in India Arabs and Egyptians, however, were the pioneers in the art of crystallising sugar many centuries later Sugar appears to have been first imported into England from the Mediterranean countries in the fourteenth century, and the art of refining introduced during the reign of Henry VIII During the seventeenth and eighteenth centuries, however, the bulk of the world's sugar was derived from America and the West Indies, where abundant slave labour and good growing conditions particularly favoured the industry

Attempts to produce sugar from sources other than cane were first made in Europe during the Napoleonic Wars, when the possibilities of utilising grapes and beetroot were investigated, but without much success in the former case With the exception of France, where the industry obtained government support, it was short lived and did not become general in Europe until 1860

Despite the development of the beet sugar industry, the importation of cane sugar into Europe continued to increase for some time, and although during the latter part of the nineteenth century the cane sugar industry suffered temporarily from severe competition, the markets gradually adjusted themselves, and in 1901–2 cane and beet each contributed about 50 per cent of the world's production of sugar Sugar beet growing was first attempted in England seventy years ago, but the industry developed but little until the raising of the subsidy in 1925

Besides the cane and beet sugar industries, the production of glucose from starch, first discovered in 1811, is an important manufacture Improved methods, the discovery of new sources of sugar, and the extension of the industry into temperate climates have enormously increased the world's supply of sugar

Although sugar, at one time a luxury, has now become an important article of food, human consumption is not likely to increase at the same rate as the supply, and it seems that a new use for sugar must be found, or further growth of the industry will be impossible The production of power alcohol from sugar seems to be the solution of the problem, and it would also provide a useful substitute for petrol before the world's store of this is exhausted The future prosperity of the sugar industry would thus seem assured

Bacterial Infection in Fish

IN the issue of NATURE dated Dec 29, 1928 (p 1012), there appeared a short notice of recent work on furunculosis in Salmonidæ by Dr Clayton and Miss I J Williamson working independently Since then, Miss Williamson has continued and extended her studies on this disease, the results of which are embodied in two papers recently published by the Fishery Board for Scotland The external signs and visceral changes in furunculosis she finds to be variable, and there may be no external symptoms, isolation of the bacillus (*B salmonicidus*) often being the only method of diagnosis [1] A notable and very important feature of the disease is that apparently healthy fish can act as 'carriers' of the bacillus, but no means has as yet been evolved for distinguishing such 'carriers' from uninfected fish while still alive Rainbow trout can also be attacked by the disease, and act as 'carriers' of it It is interesting further to note that, up to the present, no case of furunculosis has been found among salmon smolts or among kelts, nor have any such fish been found to be 'carriers', but too few fish have as yet been examined to attach any but provisional value to this statement

In the course of her investigations into furunculosis of Salmonidæ, the author has made additional general observations on bacterial infection in fish and certain other lower vertebrates [2] It is found that organisms, naturally saprophytic may under certain conditions become pathogenic Those organisms comprise types frequently found in water, such as *B fluorescens* and certain Gram negative, non sporing, non chromogenic bacilli

Bacterial disease of fish and frogs usually takes the form of a general infection Focal lesions may or may not be found In furunculosis, infection may be both focal and general Secondary infections, including ante mortem infection, are of common occurrence in fish and frogs when the resistance of the animals has been lowered by primary infection, injury, and (possibly) other adverse conditions Little or no tissue reaction against invading bacteria analogous to such reactions in mammalian animals has been found in frogs or fish, but a certain degree of phagocytic activity is displayed in some cases "It seems certain", says the author, "that many water organisms are potentially pathogenic for fish, so that when they are injured or their resistance lowered by adverse conditions, these organisms invade their tissues and usually produce a general infection Once bacteria have gained an entrance, they meet with but little opposition from the tissues and rapidly overrun the body"

[1] Fishery Board for Scotland Salmon Fisheries, 1929, No. 1 Further Studies on Furunculosis of the Salmonidæ, 1928. By Isobel J F Williamson Pp 12 (Edinburgh and London H M Stationery Office, 1929) 6*d* net

[2] Fishery Board for Scotland Salmon Fisheries, 1929 No 2 A Study of Bacterial Infection in Fish and certain other Lower Vertebrates (with a Systematic Account of the Bacteria isolated from Fish and Frogs in the course of Investigation of Furunculosis of the Salmonidæ) By Isobel J F Williamson Pp 28 (Edinburgh and London H M Stationery Office, 1929) 1*s* 9*d* net

Historic Natural Events

Feb 16–19, 1898 Dust Haze —A dense haze occurred over a large part of the eastern Atlantic off West Africa, extending for at least 1500 miles north and south and a great but unknown distance east and west The haze was caused by very fine red dust, so fine that it was impossible to sweep it up, and so dense that the sun and stars were completely obscured for two days When visible the sun was generally red, but one observer described it as "a perfect blue ball" and another as greenish At Teneriffe the occurrence was preceded by a strong and very hot southerly wind, but during the haze there was no wind Many insects were observed, of species not generally found on the island The dust evidently originated in Africa, for it was much coarser near the coast, and was thrown overboard from ships in large quantities

Feb 18, 1770 Damage by Lightning —During morning service St Keverne's Parish Church, Cornwall, was struck by lightning The vicarage seat was torn to pieces and a large piece of oak was thrown 20 feet The vicar's sister was knocked down senseless, the wooden part of one of her pattens was broken and it and her shoe were burnt, as well as parts of her clothes and body The spire was rent, and stones from it were thrown on the tops of many houses, one that fell through a roof was found to weigh 14 lb Some smaller stones were found at a distance of a quarter of a mile

Feb 20, 1661 The 'Dantzig Phenomenon' —A remarkable and extremely beautiful halo complex was seen at Dantzig between 10 30 and 11 51 A M In addition to the usual halos of 22° and 46°, the circumzenithal ring and various arcs of contact, there were no fewer than seven mock suns, some white, some of various colours, arranged with perfect symmetry This is probably the most complete optical display on record

Feb 20, 1835 Great Earthquake —Concepcion, Talcahuano, and other Chilean towns were ruined by an earthquake felt over an area of more than 400,000 square miles Sea waves, 28 feet and more in height, swept over the coast and even caused damage at Juan Fernandez, 420 miles from Chile The coast of Chile was raised by 4 or 5 feet, though it afterwards subsided by half that amount The volcanoes of the Chilean Andes, a range 150 miles in length, were unusually active before, during, and after the earthquake

Feb 21, 1861 Great Storm in Southern England —This storm was noteworthy for the destruction of a wing of the Crystal Palace and of the cathedral tower at Chichester, which fell in spite of desperate efforts to shore it up

Feb 21, 1922 Glazed Frost —During the night of Feb 21, in the region of the Great Lakes, a light rain fell at a temperature below freezing point A coating of ice formed on everything out of doors, and as the rain continued falling, the ice grew thicker Trees were so heavily coated that they began to give way and the air was full of rifle like reports as the huge limbs snapped off Sidewalks in streets were piled high, and as the rain continued whole streets became blocked as the trees were split from top to base and fell Trains ceased to run, and telegraph and telephone wires were snapped by the weight of ice Newspaper presses stopped, and only the radio enabled people to keep in touch as they could not venture into the streets Recovery was slow The train service resumed after several days, but it was months before all the telegraph equipment was replaced

Feb 21–23, 1903 Red Rain —Dust or 'red rain' fell over an area of 20,000 square miles in the southern half of England and Wales as well as in many countries on the Continent It is estimated that in England and Wales alone the total quantity of dust was not less than 10 million tons It was traced back to the Sahara, south of Morocco, where it was raised by a strong north east wind, it travelled on the western side of an anticyclone over south west Europe for a distance of at least 2000 miles in a wide sweep around Spain and Portugal, probably across the Azores In Europe the fall was associated with oppressive heat, and visibility was limited to short distances

Feb 22, 1909 Meteor Trail —A very fine meteor passed the length of the English Channel at 7 34 P M from a point 45 miles south south west of Beachy Head to 87 miles south south east of Start Point This distance of 150 miles was traversed in less than six seconds, giving a velocity of at least 25 miles per second relative to the earth at a height of about 50 miles The meteor left an unusually well developed 'streak', which was visible for nearly two hours It brightened appreciably in the first half minute, and the main part drifted gradually north westward while the ends remained almost stationary The long continued brightness of the streak was attributed to some unknown form of electrical action, possibly similar to the aurora, rather than to incandescent matter

Societies and Academies

LONDON

Royal Society, Feb 6 —**A H Davis** and **E J Evans** Measurement of absorbing power of materials by the stationary wave method The paper describes an apparatus set up for determining the acoustical absorption coefficient of small samples of material for sound, incident perpendicularly, and discusses the theory of the method and of its corrections Stationary wave coefficients for certain practical materials are compared with coefficients obtained by a 'reverberation' method, in which random incidence of sound is employed —**J W Fisher** and **H T Flint** The equations of the quantum theory These equations are obtained by analogy with Maxwell's equations applied to empty space They are expressed by means of a five dimensional system of co ordinates with the adoption of a metric after the manner of Weyl and Eddington in four dimensions The quantum problem is shown to be a radiation problem in five dimensions, and the equations proposed are invariant —**J Hargreaves** The effect of nuclear spin on the optical spectra (2) The paper contains a general method for dealing with the effect of a nuclear spin of possibly more than half a quantum, by the use of multiple wave functions, and is applied in detail to the cases of a nuclear spin of 1, 1½, and 4½ quanta respectively The interaction energy of the nucleus and electron spins is neglected, without effect on the kinematical problem of determining the multiplet intensities — **E Rudberg** Characteristic energy losses of electrons scattered from incandescent solids The velocity distribution of an initially homogeneous beam of electrons, after scattering from a solid target kept at incandescence, has been studied by means of a magnetic deflection apparatus The curves show a sharp peak due to reflected electrons and several small maxima for slightly lower values of the energy These maxima are characteristic of the substance forming the target, their positions with respect to the reflected peak remain constant for a wide range of bombarding voltages, and when target and electron gun are rotated, are also independent of angle of scattering These maxima are associated with

inelastic collisions with the target atoms, involving definite energy changes, such as excitation and ionisation.—J. A. Gaunt: Continuous absorption. This paper investigates afresh the problem of the rate of absorption of light by electrons which are initially bound to a nucleus, or free and 'colliding' with a nucleus, and after absorption are free in either case. Such a process gives rise to a continuous absorption spectrum and is the main source of the general opacity in stellar atmospheres and interiors. The interest and difficulty of the problem lie in the effective evaluation of the formal quantum theoretical expression for the absorption coefficient. Kramers' classical formula is asymptotically correct in the region in which one would expect it to be so by the correspondence principle. The deviations of astrophysical significance are found. The discrepancy between the requirements of Eddington's stellar theory and Kramers' formula is probably retained by the quantum theory of continuous absorption.

Optical Society, Jan. 16.—**O. G. Hay**: The Ross modification of the Hilger interferometer is for testing large optical elements when the free aperture of the test element is larger than the normal aperture of the interferometer. A pair of mirrors moved over the surface to be tested reflect a test beam and a reference beam and so enable any two areas to be compared. Any error introduced, by mechanical motion, into the test beam is compensated by a similar error in the reference beam. The two beams are linked together throughout the whole of the optical train of the interferometer.—**J. S. Preston**: The reflection factor of magnesium oxide. The factors were measured by means of a small integrating hollow sphere with three openings, one for illumination, another for observation through a photometer, and the third covered by a test plate or by the specimen to be examined. Results: Total factor under diffused light = 0·0974.

Apparent factor for	90°	incidence and	45°	view =	$1{\cdot}00_6$
,, ,, ,,	45°	,,	,, 90°	,,	$1{\cdot}00_0$
,, ,, ,,	diffuse	,,	,, 45°	,,	1·00
,, ,, ,,	,,	,,	,, 90°	,,	0·98

EDINBURGH

Royal Society, Feb. 3.—**R. W. Wrigley**: On changes of rock temperatures and irregularities of the earth's rotation. The investigation is based upon a series of deep rock temperatures dating from 1837 taken at the Calton Hill. After the removal of the effects of atmospheric changes at the surface, the residuals show a certain fluctuation. A fifty years' series of deep soil temperatures at Greenwich, when similarly treated for the removal of surface variations, shows similar fluctuations. There is a close correlation between these temperature variations and the minor fluctuations in the moon's longitude. Sliding of the earth's crust over the core combined with more local variations of longitude may cause the latter, and the rock temperatures would be influenced by the consequent changes of pressure in intermediate layers of the earth's crust.—**S. Williams**: The morphology of *Trichomanes aphlebioides* Christ, with special reference to the Aphlebioid leaves. *T. aphlebioides* is endemic to New Guinea where it grows on tree trunks in humid forests. It was first collected by K. Lauterbach in 1890 and briefly described by Christ in 1901. The scandent rhizome possesses a protostele similar to that of *T. scandens*. The fronds measure up to 60 cm. long and are 4-5 pinnate. In addition to these normal fronds, the plant possesses hair-like aphlebioid leaves. These latter are borne singly at the nodes, and their position and structure indicate that they are the first fronds of the axillary branches. Anatomically they show great reduction in relation to the moist and shady habitat. They may serve to promote transpiration and possibly also to protect the young fronds.—**J. S. Patel**: The presence of a kuogenic substance in the corpus luteum of the cow. The corpus luteum of the cow contains not only a hormone which produces the pregnancy changes in the genital tract (corpus luteum hormone, beta factor), but also a water soluble substance which induces beta production in the ovary of the immature mouse. This substance was mistaken by many authors for corpus luteum hormone. It resembles certain pituitary extracts in action and chemical behaviour and is perhaps identical with the supposed RHO 2.—**P. Koller**: Genetic studies on the *A* and *B* races of *D. obscura*. The taxonomist cannot distinguish *A* from *B*, but cytologically and genetically they are dissimilar. The racial hybrid male is infertile, the female fertile. Experiment involving the use of several sex-limited characters and crossing over showed that the only male which was fertile was one with a *Y* chromosome of race *B* and a racially compound *X*, the ends of which were from *B*, the middle from *A*. Crossing over in the ends of the *X* was greatly reduced in the case of the racial hybrid. There are probably genes in the ends of the *X*, physiologically dissimilar in the two races, which determine fertility. The relation of puberty to testis size and to cytoplasmic constitution is examined. No such relation exists.—**F. A. E. Crew** and **L. Mirskaia**: Maturity in the female mouse. Puberty and maturity are distinguished and defined. In this study the albinos reached puberty earlier than did the coloured; in them the cornified stage of first œstrus lasted longer before mating, and more commonly they mated at the time of the first œstrus. Pregnancy following the first œstrus was more frequent.—**Alan Mozley**: Reports of the Jasper Park Lakes Investigations, 1925–26. The mollusca of Jasper Park. The Biological Board of Canada sent two expeditions under the charge of Dr. Chas. H. O'Donoghue to Jasper National Park in the Canadian Rockies to investigate the possibilities of augmenting its fishing facilities. The present report deals with the Mollusca mainly from the systematic point of view. Forty-seven species or varieties are recorded and described, and while none of them are new they nearly all vary from the previously known forms. The collection is noteworthy in two respects: first, all the specimens were taken at altitudes between 4000 ft. and 7000 ft.; and secondly, no such detailed study of fresh water mollusca has been made within a radius of 2000 miles. This report is intended to be preliminary to one dealing with the ecology of the group.

PARIS

Academy of Sciences, Jan. 6.—**Gabriel Bertrand** and **M. Mokragnatz**: The distribution of nickel and cobalt in plants. Nickel and cobalt have been found in all the plants examined. The quantities of nickel found, expressed on the dry material, range from 0·02 parts per million in polished rice to 3·5 parts per million in an edible fungus, *Cantharellus cibarius*. The proportions of cobalt are usually from one-fifth to one-tenth of the nickel present.—**Paul Pascal**: Amides and imides derived from vanadium. A study of the interaction of ammonia and vanadyl chloride at different temperatures. At −80° C. vanadyl amide, $VO(NH_2)_2$ is produced, but cannot be separated from ammonium chloride; at 85° C. or higher temperatures the imide VONH is formed.—**V. Lalan**: The fundamental tensors of plane varieties.—**Jacques**: Certain networks traced on quadrics.—**Maurice Janet**: A series of functions considered by Hermite and its application to a problem of the calculus of variations.—**R. Tambs Lyche**: A problem of interpolation.—

Vladimir Bernstein The regions of holomorphy of the series of Dirichlet —**Giulio Krall** The variation of domain in the problem of Dirichlet —**Fr Girault** The law of gravitation —**Maurice Nuyens** A new method of integration of gravific equations of a massic and electromagnetic field with spherical symmetry —**J F Cellerier** The scientific analysis of musical sounds The principle of the method employed is based on the conversion of the acoustic phenomena into electrical vibrations the characteristics of which can be determined with a high degree of precision As an example, the results of the examination of the note emitted by a motor horn is given —**J B Galle** and **G Talon** Researches relating to the propagation of radioelectric waves carried out on the occasion of the eclipse of May 9, 1929 In recognition of the importance of researches on the propagation of radio electric waves in its relations with solar activity, arrangements were made, on the occasion of the solar eclipse expedition to Indo China, to carry out measurements of the electric field produced by distant wireless stations, observations on atmospherics, and the apparent variations of emitting station as given by radio goniometry A summary of the results obtained is given —**G Ferrié** Remarks on the preceding note Comments on the results obtained in connexion with retarded wireless echos —**J Perreu** The limiting heat of solution of hydrated manganese chloride —**R Levaillant** Some reactions of sulphurous and carbonic esters Description of the preparation and properties of the compounds $SO_2[CH(CH_2Cl)_2]$, $(CH_2Cl)_2$ CH SO_2Cl, and $(CH_2 \; CH_2Cl)_2SO_4$ —**M Tiffeneau, Mlle Jeanne Lévy, and E Ditz** Some pairs of amino alcohols The preparation of each isomer separately In the preparation of the amino alcohols $ArAr'C(OH)CH(NH_2)CH_3$ by the interaction of the organo magnesium compounds with amino ketones, either of the two stereoisomeric forms predicted by theory can be obtained at will by inverting the order of introduction of the radicles Ar and Ar′ —**Raymond Delaby** and **Raymond Charonnat** The synthesis of dioxypyramidon —**Pierre Viennot** Intrusions of the Trias in the Adour basin —**Marcel Casteras** The structure of the mountains of Gar and Cagire (Haute Garonne) —**Louis Dangeard** Algal reefs and pebbles in the ferruginous oolite of Normandy —**Mlle A Dusseau** The chlorophyll of the leaves of wheat Physical measurements of alcoholic extracts of chlorophyll may serve for the identification of the variety of wheat —**Alphonse Labbé** The pallial organs of some Dorididæ —**A Policard** and **M Boucharlat** Contribution to the study of pulmonary anthracosis The tolerance of cultures of tissues towards particles of coal Results of growing lung tissue from the embryo fowl in plasma containing fine particles of coal in suspension No poisonous action of the coal could be detected These experiments tend to confirm the view that pulmonary anthracosis is an anatomical state and not a disease —**C N Dawydoff** The larvæ of the Polyclades of the coasts of Annam —**Emile F Terroine** and **Fr Szucs** The relation between amino puric nitrogen and proteid nitrogen in micro organisms —**H Hermann, F Caujolle, and F Jourdan** The elimination of some alkaloids and some genalkaloids by the bile ducts The presence in the bile of quinine, nicotine, strychnine, and genostrychnine, atropine, and genatropine has been proved —**R Fosse, A Brunel, and P de Graeve** A new fermentation of uric acid produced by the liver of various animals Uric acid can be totally converted into allantoin by a ferment in horse liver or by the liver of *Rana viridis* —**Mlles Marguerite Champagne** and **Gilberte Mourot** The estimation of allantoin in animal urine —**J Magrou** The interpretations of biological actions at a distance —**H Bordier** The efficacy of medical d'Arsonvalisation in erythematous lupus

GENEVA

Society of Physics and Natural History, Nov 21 —**G Tiercy** The new refrigerating installation of the chronometric department of the Observatory of Geneva The Observatory of Geneva has recently completely reorganised its chronometer service In particular, an apparatus has been set up for testing chronometers with a modern automatic refrigerator, this installation can keep a temperature in the chronometer chamber which is constant within 0 2° C The same constancy can be maintained in the chambers used for higher temperatures —**R Wavre** A possible agreement between geodesy and the theory of the precession of the equinoxes D'Alembert put the following problem Are the geodesic measurements of the terrestrial flattening entirely included between the limits which are assigned to them by the theory of precession? Poincaré showed that the studies, to the first approximation, of Clairaut and his successors led to a disagreement He did not determine the agreement possible using the second approximation The author, who has made a methodical study of the second approximation, shows that this agreement is possible The problem of D'Alembert may be solved without abandoning the fluid character of the earth considered as a whole —**E Briner** and **H Kuhn** Some new ammonia addition compounds of phenols On the basis of a manometric method, the authors have detected and characterised by their formulæ, dissociation pressures and heats of formation, numerous new compounds formed by ammonia with phenols, naphthols, oxy anthraquinones, and substituted derivatives of these substances —**B Susz** and **E Briner** The true energy yields in the production of ozone by the silent discharge and their improvement The authors have established by electrical and calorimetric methods the true yields in the production of ozone by the silent discharge These yields, improved by cooling, exceed 200 grams of ozone per kilowatt hour This makes the use of ozone particularly economical

LENINGRAD

Academy of Sciences (*Comptes rendus*, No 20, 1929) —**P Lazarev** and **L Teile** The action of blood vessel dilators on the sensitiveness of the eye in peripheral vision Experiments were made with amyl nitrite and nitroglycerine and it was found that these substances cause after the first 1 3 minutes a sharp decrease in the sensitiveness of the eye, then an increase occurs and after 5 9 minutes the sensitiveness becomes more than double the normal minimum —**P Lazarev** and **N I Kolesnikova** The staining of boric glass by the action of radium rays No effect has been observed from the action of γ rays, β and γ rays acting together produce a purplish brown stain, the combined action of α and β rays results in producing a substance with a high absorption in the blue part of the spectrum and smaller absorption in the red part The substances produced by α and β rays possess a different velocity of reverse trans formation under the influence of benzole and of high temperature —**P Lazarev** and **N Rodzevitch** The phenomena of ionisation of a gas during the discoloration of colouring substances in visible and in ultra violet light While there is no ionisation effect when cyanine is discoloured by the action of ordinary light, the action of ultra violet rays produces ionisation Similar results have been obtained with crystal violet —**A N Tsvetkov** The theory of physiological units The physiological unit is the

minimum quantity of the living substance which is still excitable Theoretical calculations show that the unit should be about μ^3 in size —A I Leskov The occurrence of *Buxus sempervirens* L in the northern Caucasus The forests in which boxtrees are found contain about 75 per cent of species of plants which must be regarded as Tertiary relics

Official Publications Received

BRITISH

Memoirs of the Punjab Irrigation Research Laboratory Lahore Vol 1 No 3 A Statistical Examination of the Discharge of the Indus at Sukkur and its Relation with Up stream Sites By B H Wilsdon with R Partha Sarathy Pp 40 (Lahore) 1 12 rupees, *2s 4d*

The Journal of the Quekett Microscopical Club Edited by W S Warton Ser 2, Vol 16, No 96, December Pp 95 150 (London Williams and Norgate Ltd) *5s* net

The British Electrical and Allied Industries Research Association (Incorporated) Ninth Annual Report, October 1, 1928, to September 30 1929 Pp. 75 (London)

Transactions of the Royal Society of Edinburgh Vol 56 Part 2 No 18 Notes on the Development of Callichthys littoralis By Frances M Ballantyne Pp 437 466+8 plates (Edinburgh Robert Grant and Son London Williams and Norgate Ltd) *5s*

Department of Scientific and Industrial Research Building Science Abstracts Compiled by the Building Research Station and published in conjunction with the Institute of Builders Vol 2 (New Series), No 12, December 1929 Abstracts Nos 2444 2646. Pp v+425 548 (London H M Stationery Office) *9d* net

The Marine Biological Station at Port Erin (Isle of Man) being the Forty third Annual Report of the former Liverpool Marine Biology Committee now the Oceanography Department of the University of Liverpool Drawn up by Prof Jas Johnstone Pp 81 (Liverpool University Press of Liverpool) *1s 6d* net

The North Staffordshire Field Club Transactions and Annual Report 1928-29 Vol 63 Pp 178 (Stafford) *7s 6d*

Geological Survey Department Tanganyika Territory Short Paper No 4 The Soil and Agricultural Development in relation to the Geology of portions of the Northern Kigoma and Southern Bukoba Provinces By Dr E O Teale Pp 32 (Dar es Salaam Government Printer) *4s*

Transactions of the Institute of Marine Engineers Incorporated Session 1929, Vol 41 January Pp 885 981 (London)

Dominion Museum Wellington New Zealand Bulletin No 12 Fishing Methods and Devices of the Maori By Elsdon Best Pp viii+230 (Wellington N Z W A G Skinner London New Zealand Government Office) Paper, *9s* cloth *11s*

FOREIGN

Department of the Interior U S Geological Survey Water Supply Paper 607 Surface Water Supply of the United States 1925 Part 7 Lower Mississippi River Basin Pp iv+118 20 cents Water-Supply Paper 608 Surface Water Supply of the United States 1925 Part 8 Western Gulf of Mexico Basins Pp vi+268 30 cents Water-Supply Paper 609 Surface Water Supply of the United States 1925 Part 9 Colorado River Basin Pp v+145 15 cents Water Supply Paper 610 Surface Water Supply of the United States 1925 Part 10 The Great Basin Pp. v+141 20 cents Water Supply Paper 613 Surface Water Supply of the United States 1925 Part 12 North Pacific Slope Drainage Basins B Snake River Basin Pp vi+271 30 cents Water-Supply Paper 614 Surface Water Supply of the United States, 1925 Part 12 North Pacific Slope Drainage Basins. C Pacific Slope Drainage Basins in Oregon and Lower Columbia River Basin Pp vi+198 30 cents Water-Supply Paper 636 B Suspended Matter in the Colorado River in 1925–1928 By C S Howard (Contributions to the Hydrology of the United States 1929) Pp ii+15-44 (Washington D C Government Printing Office)

Department of the Interior U S Geological Survey Bulletin 810 B The Chandalar Sheenjek District, Alaska By J B Mertie, Jr (Mineral Resources of Alaska, 1927 B) Pp ii+87 139+2 plates Bulletin 812 B The Kevin Sunburst Oil Field and other Possibilities of Oil and Gas in the Sweetgrass Arch Montana. By Arthur J Collier (Contributions to Economic Geology 1929 Part 2) Pp iv+57 189+plates 11 18 30 cents (Washington D C Government Printing Office.)

Department of the Interior U S Geological Survey Professional Paper 158 B The Contact of the Fox Hills and Lance Formations By C E Dobbin and John B Reeside, Jr (Shorter Contributions to General Geology 1929) Pp ii+9 25+plates 4 5 (Washington D C Government Printing Office)

Contribution from the Cenozoic Laboratory of the Geological Survey of China and the Department of Anatomy Peking Union Medical College, Peking Vol 8, No 1 Bulletin of the Geological Survey of China Preliminary Note on Additional *Sinanthropus* Material discovered in Chou Kou Tien during 1928 By Prof Davidson Black Pp 15 20+6 plates (Peking)

Institut de France Académie des Sciences Annuaire pour 1930 Pp 390 (Paris Gauthier Villars et Cie.)

University of Illinois Engineering Experiment Station Circular No 18 The Construction, Rehabilitation and Maintenance of Gravel Roads suitable for Modern Traffic By Prof Carroll C Wiley Pp 57 30 cents Circular No 19 Equipment for Gas Liquid Reactions By Prof Donald B Keyes Pp 14. 10 cents (Urbana, Ill)

United States Department of Commerce Bureau of Standards Research Paper No 112 Optical Heterogeneity of a Fused Quartz Disk By L W Tilton and A Q Tool Pp 619 628 5 cents Research Paper No 113 Data on Ultra Violet Solar Radiation and the Solarization of Window Materials By W W Coblentz and R Stair Pp 629 639 15 cents (Washington, D C Government Printing Office)

CATALOGUES, ETC

The Nickel Bulletin Vol 3, No 1 January Pp 40 (London The Mond Nickel Co, Ltd)

Illustrated Catalogue of the Will Day Historical Collection of Cinematograph and Moving Picture Equipment, for Sale by Tender Pp 56+24 plates (London Harris and Gillow)

Catalogue of Scientific Journals and Transactions of Learned Societies a Selected List of Books on Travel Topography, Ethnology Anthropology and kindred Subjects, Books on Economics Statistical Literature and Business etc (N S No 2) Pp 8? (London Wm Dawson and Sons, Ltd)

Calendar for 1930 (London Express Letter Service)

Eastman Organic Chemicals List No 21, January Pp 9? (Rochester, N Y Eastman Kodak Co)

Diary of Societies

FRIDAY FEBRUARY 14

GENETICAL SOCIETY (at John Innes Horticultural Institution Merton) at 2 30 —Experiments on *Primula Sinensis* —Miss de Winton and J B S Haldane Demonstration of the Genetics of Diploid and Tetraploid Forms —Dr C D Darlington Exhibition of Cytological Preparations of the Tetraploid —Dr F W Sansome Exhibition of Slides Illustrating Pollen Behaviour in the Tetraploid —J B S Haldane The Genetics of the Tetraploid

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 4 —E W Hey Groves The Hunterian Oration

ROYAL ASTRONOMICAL SOCIETY (Annual General Meeting), at 3 —President's Address on the Award of the Gold Medal to Dr J S Plaskett for his Valuable Observations of Stellar Radial Velocities and the Important Conclusions derived from them

PHYSICAL SOCIETY (at Imperial College of Science), at 5 —W E Summerhays The Diffusion Constant of Water Vapour —M C Johnson A Method of Calculating the Numerical Equation of State for Helium below 6 Absolute and of Estimating the Relative Importance of Gas Degeneracy and Interatomic Forces —F D Smith The Magnetostriction Constant for Alternating Magnetic Fields —Demonstration by D Kompson of A Working Model Illustrating the Mosaic Theory of the Compound Eye due to Altenburg

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts) at 5 30 —Prof A F C Pollard Optical Aids to Engineering Inspection

ROYAL SOCIETY OF MEDICINE (Clinical Section) at 5 30

MALACOLOGICAL SOCIETY OF LONDON (Annual Meeting) (at Linnean Society of London) at 6 —H Watson (*a*) On the Anatomy and Affinities of *Plicatula* (*b*) On the Central Nervous System of *Spondylus* —J R le B Tomlin Some Preoccupied Generic Names II —Dr F A Schilder Remarks on Type Specimens of some Recent *Cypraeidae* —Exhibit *Cypraea Arabica* Group Eggs and Spawn of Terrestrial Mollusca

INSTITUTION OF LOCOMOTIVE ENGINEERS (Manchester Centre) (at 36 George Street Manchester), at 7 —K W Willans Water tube Boilers Suitable for Locomotives

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7 —G S Taylor Lantern Lecture

OIL AND COLOUR CHEMISTS ASSOCIATION (Manchester Section) (at Milton Hall Manchester) at 7 —R. G Daniels Common Sense and Nitrocellulose Lacquer

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College Cardiff) at 7 15 —E A Rudge Timber as a Material of Construction

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at King's Head Hotel Coventry) at 7 30 —L H Pomeroy The Double six Engine

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting) at 7 30 —Technical Film—The Manufacture of Staybrite and Stainless Steels

INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University) at 7 30 —S Matthews Recent Developments in Measuring Instruments

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) at 8 —F Moore Unusual Coloration of Scleroticа —R Pickard The Red Field and Optic Disc Resistance in Glaucoma and Allied Conditions

ROYAL INSTITUTION OF GREAT BRITAIN at 9 —Prof A F Pollard History *à la Mode*

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch) (at Yeovil).—Flight Lieut H R W Waghorn The Schneider Trophy Contest of 1929

SATURDAY, FEBRUARY 15

ROYAL INSTITUTION OF GREAT BRITAIN at 3 —Rev G Cooke Tonality and Expression in Song Writing

MONDAY, FEBRUARY 17

VICTORIA INSTITUTE (at Central Buildings Westminster) at 4 30 —Brig Genl H Biddulph The Date of Ecclesiasticus

ROYAL SOCIETY EDINBURGH at 4 30 —Prof Carl Størmer Do the Wireless Echoes of Long Delay come from Space Outside the Moon's Orbit?

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5 —Lt. Col R. C F Schomberg Climatic Conditions in the Tarim Basin.

ROYAL COLLEGE OF SURGEONS OF ENGLAND at 5 —R H O B Robinson The Rôle of Short Circuit Operations in the Treatment of Cholecystitis

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7 —M E Fox, W E Warrilow, and others Discussion on The Nickel Iron Battery and its Uses —E C McKinnon and others Discussion on The Lead Battery and its Uses

INSTITUTION OF MECHANICAL ENGINEERS (Graduates Section—London), at 7 —W W S Robertson Strip Rolling Mills and Auxiliary Machinery

TEXTILE INSTITUTE (London Section) (at Barrett Street Schools), at 7 —R. J Steele Man's Quest for Fibres.

BRADFORD TEXTILE SOCIETY (at Midland Hotel, Bradford), at 7 30 —W Hunter Some Reflections on Wool and its Uses

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales—Liverpool—Centre) (at Liverpool University), at 7 30 —Capt. P P Eckersley Broadcasting by Electric Waves (Faraday Lecture).
ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8 —Prof P Abercrombie The Thames Valley Preservation Scheme.
ROYAL SOCIETY OF ARTS, at 8 —A B. Searle Recent Improvements in Methods of Brickmaking (Cantor Lectures) (1).
INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Society of Chemical Industry—Edinburgh and East of Scotland Section) (at North British Station Hotel, Edinburgh), at 8 —Prof A. J Clark Drugs Manufactured by the Body
MEDICAL SOCIETY OF LONDON at 8 —Dr J W Thomson Walker Enlarged Prostate and Prostatectomy (Lettsomian Lectures) (1).

TUESDAY, FEBRUARY 18

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Sir William Bragg X ray Determination of the Structure of Cellulose and Similar Substances (2)
ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5 15 —Prof M Greenwood The Vaccination Problem.
ROYAL SOCIETY OF MEDICINE at 5 30 —General Meeting
ZOOLOGICAL SOCIETY OF LONDON, at 5 30 —H A. Gilbert Exhibition of Cinematograph Films of British Birds —O W Richards The British Species of Sphæroceridæ (Borboridæ Diptera).—S Zuckermann A Rhesus Macaque (*Macaca mulatta*) with Carcinoma of the Mouth —Dr Isabella Gordon African Fresh water Prawns of the Species *Caridina nilotica* Roux with Special Reference to the Nile Basin.—Dr C J van der Klaauw On the Tympanic Region of the Skull in the *Megatherium* —Dr J R Baker The Breeding season in British Wild Mice
ILLUMINATING ENGINEERING SOCIETY (at 15 Savoy Street) at 6 30 —W H Villiers Modern Incandescent Lighting in Kinema Studios
LONDON NATURAL HISTORY SOCIETY (at Winchester House, E C), at 6 30 —H R. Hewer The Colour of Fish and how they change it
INSTITUTION OF ELECTRICAL ENGINEERS (North Western Centre) (at Engineers Club Manchester), at 7 —J G Wellings and C G Mayo Instrument Transformers
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members and Graduates Section) (Manchester and District Branch) (at Milton Hall, Manchester), at 7 —F C Lant Kitchen Equipment
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN at 7 —Dr W Clark The Formation of a Photographic Image
INSTITUTION OF AUTOMOBILE ENGINEERS (Wolverhampton Centre) (at Engineering and Scientific Club Wolverhampton) at 7 30 —J H Pomeroy The Double six Engine
SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield), at 7 30 —H E Kershaw Cobalt Magnet Steels

WEDNESDAY, FEBRUARY 19

ROYAL METEOROLOGICAL SOCIETY, at 5 —C K M Douglas The Cyclonic Depressions of November 16 and 28, 1928 —Discussion on memoir by Dr G C Simpson on The Distribution of Terrestrial Radiation
ROYAL COLLEGE OF SURGEONS OF ENGLAND at 5 —W McAdam Eccles Anatomy Orthodox and Heterodox in Relation to Surgery
ROYAL STATISTICAL SOCIETY (at Royal Society of Arts) at 5 15
NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at Institute of Marine Engineers) at 5 30 —Eng Capt. E C Smith Pioneer Ships of the Atlantic Ferry
ROYAL AERONAUTICAL SOCIETY (at Institution of Electrical Engineers), at 6 30 —Dr W Georgii and Herr Stamer Gliding
INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub Centre) (at Royal Victoria Hotel, Sheffield) at 7 30 —Sir T F Purves Address
ROYAL SOCIETY OF ARTS, at 8 —Alfred Stevens Architect Sculptor Painter
FOLK LORE SOCIETY (Annual General Meeting) (at University College) at 8 —Presidential Address
ROYAL MICROSCOPICAL SOCIETY at 8 —Dr R S Clay and T H Court Early Achromatic Microscopes by James Smith —D V Daran (*a*) Coincident Images made use of in Mycological and Bacteriological Works with Reference to Single Spore Cultures (*b*) Reflection Magnification used for Physiological Experiments connected with Transpiration (*c*) Note on illuminating Objects for Microscopical Examination
ST PAUL'S ECCLESIOLOGICAL SOCIETY (at Royal Institute of British Architects) at 8 —H L Mann Baptismal Fonts

THURSDAY, FEBRUARY 20

ROYAL SOCIETY at 4 30 —*Papers probably to be read* —A C Davies Prof F Horton, and E Blundell Critical Potentials for the Excitation of Soft X Rays from Iron —Prof A V Hill A Thermal Method of Measuring the Vapour Pressure of an Aqueous Solution —M Nottage The Passive State of Adhesion
LINNEAN SOCIETY OF LONDON, at 5 —Symposium on Lampreys and Ostracoderms Speakers Sir Arthur Smith Woodward, Prof E S Goodrich, Prof D M S Watson, Dr C Tate Regan G R de Beer
ROYAL INSTITUTION OF GREAT BRITAIN at 5 15 —T A Joyce Architecture and the Industrial Arts of Pre Spanish America (2)
CHILD STUDY SOCIETY (at Royal Sanitary Institute), at 6 —Miss Muriel A Payne Homeless Children
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group—Informal Meeting) at 7 —Discussion on Some Technical and Practical Aspects of Colour Photography
BATLEY AND DISTRICT TEXTILE SOCIETY (at Batley Technical College), at 7 30 —Dr A W Stevenson Testing of Textiles.
INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College, Dublin), at 7 45 —B A G Churcher and A. J King The Analysis and Measurement of the Noise emitted by Machinery
CHEMICAL SOCIETY, at 8 —Prof. T M Lowry and G Jessop The Properties of the Chlorides of Sulphur Part III Dielectric Constants Part IV Density and Surface Tension —G A C Gough and H King Trypanocidal Action and Chemical Constitution Part IX Aromatic Arsinic Acids Containing an Amide Group.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE, at 8.15 —Dr V B Wigglesworth Some Notes on the Physiology of Insects related to Human Disease
BRITISH INSTITUTE OF RADIOLOGY, at 8 30 —Dr A E Barclay Mechanism of Swallowing —Dr J P Maxwell Osteomalacia and Fœtal Rickets —Dr J Muir The Irritable Colon
ROYAL AERONAUTICAL SOCIETY (Coventry Branch) (at Coventry) —Flight-Lieut. H R W Waghorn The Schneider Trophy Contest of 1929
ROYAL AERONAUTICAL SOCIETY (Yeovil Branch) (at Yeovil).—Squadron Leader J J Breen The Westland Wapiti in Iraq
SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Newport).—D Griffiths Tinplate Industry

FRIDAY, FEBRUARY 21

TEXTILE INSTITUTE (Lancashire Section) (at Textile Institute, Manchester), at 1 15.—J Smeaton Textile Specifications and their Preparation
ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botany Lecture Room Imperial College of Science and Technology) at 2 30.—Dr W R Thompson Biological Control of Injurious Insects and Weeds
GEOLOGICAL SOCIETY OF LONDON (Annual General Meeting), at 3 —Presidential Address
MEDICAL OFFICERS OF SCHOOLS ASSOCIATION (Annual General Meeting) (at 11 Chandos Street W 1) at 5 —Dr G E Friend Some Notes on the Value of Clinical Dietetic and Physical Records in Public Schools (Presidential Address)
ROYAL SOCIETY OF MEDICINE (Balneology Section), at 5 —Dr J B Burt and others Discussion on Bath Reaction in Spa Treatment
BRITISH INSTITUTE OF RADIOLOGY (Medical Meeting), at 5 —Radiology in Gastrointestinal Diseases
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —E R Flint The Association between Gall Bladder Lesions and Hepatitis in the Human Subject
SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (jointly with Manchester Section) (at Liverpool University) at 6 —J Twomey Flour Milling
NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle upon Tyne) at 6 —Rear Admiral W Scott Hill Powdered Coal for Ship Propulsion
INSTITUTION OF MECHANICAL ENGINEERS (Annual General Meeting) at 6 —Annual Report Discussion on Sixth Report of the Steam Nozzles Research Committee
INSTITUTION OF ELECTRICAL ENGINEERS (London Students Section), at 6 15 —S H Hart Paper Insulated Power Cables
TEXTILE INSTITUTE (London Section) (at Chemical Society) at 6 45 —F I Goodall Diagnosis of Colour Faults in Finished Goods
BEDSON CLUB (at Armstrong College Newcastle upon Tyne) at 6 30 —Sir James Walker Kolbe's Electrosynthesis (Bedson Lecture)
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7 —R H Lawton Pictorial Essentials
GEOLOGISTS ASSOCIATION (North East Lancashire Group) (at Blackburn Technical College) at 7 —Miss E J Wood A Visit to East Sutherland
JUNIOR INSTITUTION OF ENGINEERS at 7 30 —E P S Gardner The Application of Electric Welding to the Erection and Strengthening of Steel Structures
ROYAL SOCIETY OF MEDICINE (Obstetrics and Electro Therapeutics Section) at 8 —Special Discussion on The Position of Radium in Treatment of Gynæcological Conditions Openers M Donaldson and S Dodd Obstetrics Dr A E H Pinch and Dr J E A Lynham, Electro Therapeutics
ROYAL INSTITUTION OF GREAT BRITAIN at 9 —J B S Haldane Principles of Plant Breeding
SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester) —Prof McSwiney The Problem of the Fastness of Dyes to Perspiration

SATURDAY FEBRUARY 22

GEOLOGISTS ASSOCIATION (in Natural History Museum, South Kensington), at 2 30 —Dr W D Lang Demonstration of Palæontology and the Public
NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Newcastle upon Tyne) at 2 30
ESSEX FIELD CLUB (at West Ham Municipal College), at 3 —Celebration of 50th Anniversary
ROYAL INSTITUTION OF GREAT BRITAIN at 3 —W Rothenstein Nineteenth Century Painting in France and England (1)
OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB.—Exhibition Meeting

PUBLIC LECTURES

SATURDAY FEBRUARY 15

HORNIMAN MUSEUM (Forest Hill) at 3 30 —Dr C Ainsworth Mitchell Tell tale Inks

MONDAY, FEBRUARY 17

UNIVERSITY OF LEEDS at 8 30 —S C Kaines Smith Aspects of Italian Painting (Succeeding Lectures on Feb 24 and Mar 3)

TUESDAY, FEBRUARY 18

GRESHAM COLLEGE, at 6 —W H Wagstaff Geometry (Succeeding Lectures on Feb. 19, 20, and 21)

WEDNESDAY, FEBRUARY 19

BELFAST MUSEUM at 8 —Miss W J Sayers The Dispersal of Seeds

FRIDAY, FEBRUARY 21

KING'S COLLEGE, at 5 30—Sir Rennell Rodd Survivals of Ancient Myth in Modern Greek Folk lore
SURVEYORS INSTITUTION at 5 30 —R A Watson Watt What is wrong with Wireless? (Lecture in connexion with Institution of Professional Civil Servants)

SATURDAY, FEBRUARY 22

HORNIMAN MUSEUM (Forest Hill), at 3 30 —Miss I D Thornley Sanctuary in the Middle Ages

SATURDAY, FEBRUARY 22, 1930

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Education for Environment[1]

UNTIL a few years ago the various local governments in British Africa could justly have been accused of indifference to the educational needs of the native peoples committed to their care Within the past few years, however, these same governments have given welcome evidence of their growing belief in education as the principal factor in the development of the capacities of the African peoples, and the need for supplementing the work of the various missionary bodies in the field of education They have been given much encouragement in their efforts to improve native education by the Advisory Committee on Education in the Colonies, which from its inception has had at its command the services of Major Hanns Vischer, who combines a genuine enthusiasm for education with an almost unique knowledge of the peoples of Africa and a sympathetic understanding of their needs Equally important has been the stimulus given to educationists in Africa by Mr Ormsby-Gore, Mr Jesse Jones and his associates, and the members of the Hilton Young Commission, all of whom have visited Africa within the past six years

In addition to the encouragement and stimulus from without, local governments find they are being urged from within to increase the educational facilities for the natives The natives themselves are almost clamorous in their demands for education, particularly 'education by the book', just as in India, since the capacity to read and write in the language of the dominant whites gives those who possess it a comfortable feeling of superiority over those who do not, especially as it carries with it the possibility of clerical or other semi professional work for government or for the trading community, and this work is the best paid

In striking contrast to the thirst for instruction exhibited by the Africans is the comparative indifference of the adult members of the white-settled communities in tropical and sub tropical Africa to the educational needs of white children In Kenya, Tanganyika, Nyasaland, Northern Rhodesia and Southern Rhodesia, there are many white children who are receiving practically no formal instruction at all, with the inevitable result that in each of these territories there is growing up a class of illiterate whites If this state of affairs is not soon ended, each of these territories will have its own 'poor white' problem, a problem which is already intense in the Union of South Africa and

[1] Southern Rhodesia Report of the Education Commission Pp ii+187 (Cape Town *Cape Times*, Ltd, 1929)

is causing much anxiety to the Union Government, for the 'poor white' is an unemployable, too ignorant and incompetent to be worth employing in a skilled capacity, but cursed with a superiority complex which prevents him from seeking employment in occupations regarded as only fit for blacks

Even those white parents in these territories who do send their children to the schools provided by the Government or voluntary bodies are almost without exception uncritical of the instruction given They are apparently pathetically content that such instruction should be almost identical in form and substance with that which is provided in the schools in Great Britain The majority of these white children will probably never leave Africa, essentially an agricultural continent, only a very few will proceed to a university, but their school studies are almost exclusively literary, more so than in the average grammar school in Great Britain, divorced from the realities of their environment and more likely to engender distaste for African life than to inculcate an intelligent appreciation of the significance of Africa in world economics and politics or a sympathetic understanding of its peoples, without both of which the assumption of leadership by the white minorities in Africa is an impertinent presumption

World opinion now demands that the whites in Africa should equip themselves for leadership An essential part of this equipment is the capacity to adapt themselves to the changed order of things The exploitation of the Africans by the immigrant races is no longer condoned by most of the governments in Africa The prosperity of the whites has to be based on something other than the misery of the blacks It can be attained by the development of the other natural resources of the continent The development of these resources, animal, vegetable, and mineral, is obviously dependent upon the quality of the co operation between the Africans and the whites, and this in turn is determined by the "right adjustment between the developing human organism and its surroundings" (Sir Richard Gregory's definition of education), whether the human organism be white or black

The school, it is true, is only one of the many forces at work to secure this adjustment, but it can be made the most potent of them all, if it provides "an education that works and moves entirely amid the facts and circumstances which make up the texture of life for its pupils", the aim set forth in the recent published report of the Education Commission, which was appointed at the beginning of 1929 by the Governor of Southern Rhodesia, Sir Cecil Rodwell, to inquire into the present system of education, other than native education, of that colony

This Commission surveys with admirable clarity and understanding the facts and circumstances of the life of the white settled community in Southern Rhodesia The white colonists, mainly of British stock, comprise less than 5 per cent of the total population, but they are the dominant political power The natives are docile and intelligent The Asiatic element in the population is very small as compared with that in the Union of South Africa or Kenya, and there is no Arab slave tradition as in eastern Africa It is a country of known great natural resources, both agricultural and mineral, and still greater possibilities It enjoys a fine climate It is situated in the midst of other great productive areas and is across the main lines of communication of the southern part of Africa Its political, economic, and social development is bound to exert a powerful influence on such development in other African colonies Also, since the determining factor in this development will be the white minority, it is all important that this white minority should be provided with an education which will fit it for its great responsibilities "In a community of white people set amidst a great black population", says the Commission, "the obligation to give every white child the most complete education which he is capable of receiving must be accepted at whatever cost"

The Commission considers that the main permanent objectives which a system of education for the white community in Southern Rhodesia must have in view are

1 "The continuance in full strength of the European inheritance"

2 The erection and maintenance of "a community that will be, in every aspect of its life, characteristically Rhodesian"

3 The development in the youth of the country of "the moral stamina to overcome the strong and subtle influences which, in a mixed society like that of Rhodesia, are constantly at work to sap the energies and weaken the moral tenacity of the privileged European"

4 "The development and wise use of the great natural resources of the country"

For the attainment of the first objective the Commission regards it as essential that not only teachers, but also other educating agencies, must continue to come from Europe, particularly from Great Britain, for this will ensure that the common store of achievement in literature and art and the

general apparatus of civilised life will be drawn directly from the source, to provide for those born in a hitherto barbarous land such as Southern Rhodesia "the best substitute for that rich background of long established civilisation which is the unconscious inheritance of every child in an older community" As regards the second objective, the Commission lays emphasis on the educative value of the study of 'the natural life of Rhodesia, its plants, animals, insects, climatic phenomena and so forth, the life of the natives which so intimately and subtly concerns the welfare of every child, the main industries the history of African settlement"

Regarding the third objective the Commission refers to "the danger of moral degeneration which threatens the youth of a country, where the services of others are so easily come by, and where the labour that serves the first needs of life is apt to be despised as menial and dishonouring" It recommends strongly that the expert aid of psychologists should be enlisted to investigate the influences on the life of white children through their many contacts with the native peoples, particularly in connexion with the attitude of the former to the latter The fourth objective will be best attained, it believes, by the multiplication of centres to provide facilities for training skilled workers, and better and more systematic co operation between the schools on one hand and organised industry and the technical departments of Government on the other

There follows a critical survey of the existing facilities for the education of the whites in Southern Rhodesia Various recommendations are made for the improvement of the system Southern Rhodesia is warned of the dangers of parochialism in education, and in particular is advised to lose no opportunity for friendly and fruitful co operation with the Union of South Africa Equally important are the suggestions made for the co operation of parents with school authorities The tendency on the part of parents to regard teachers as a class apart, and schools as institutions with no links with the homes of the scholars, is not uniquely a Southern Rhodesian phenomenon it is almost universal In this connexion the Commission's suggestion, that one means of promoting co-operation between parents and the education authorities would be by designing better home tasks for pupils, merits the most careful consideration in Great Britain

This is by no means the only need Southern Rhodesia and Great Britain have in common Where secondary schools exist in any British colonies, they appear to be based on home models, that is to say, the school curricula are designed to meet the needs of the universities to which only a very small proportion of secondary school scholars will proceed Parents and the public generally condone this, the former because they lack the courage to resist the demand by employing bodies for the stereotyped educational hall marks prescribed by universities The needed change will only be brought about, as the Commission states, by the public realising that Secondary schools should be regarded as the final stage of school education for the many rather than as the preparatory stage for the few" The need in all countries of the Empire is for the provision of a variety of secondary courses of equal status, not "one selected body of studies having a traditional pre eminence over others, any more than it can be regarded as the exclusive privilege of a select class" In any course, however, the Commission strongly recommends the inclusion of manual training and general science subjects, including biology What is surprising is the reaction of the Commission to the suggestion made by certain witnesses that some provision should be made in the white schools for the study of native languages The Commission says quite definitely that "the advantage to be gained from the introduction of native languages as a school study is not sufficiently great to justify the encroachment that would be involved on the time available for other studies"

A chapter of the report is devoted to agricultural education "Comparatively little has been done in Rhodesian schools to develop interest in the problems and the life of the countryside, and to produce what may be called rural mindedness" This the Commission attributes mainly to the fact that primary education in the Colony has been dominated by secondary education, and the secondary schools have been developed under teachers whose own education and training have been in the main on purely academic lines" But Rhodesian parents also object to their children "digging and hoeing", or doing any other form of manual work, since such occupations are regarded as 'Kaffir' work, too degrading for whites The result in Rhodesia as elsewhere is the progressive migration of the rural population to the towns

The staffing of the white schools in Rhodesia is adequate to the extent of generosity, but there is an undue proportion of untrained teachers, particularly in the secondary schools This the Commission regards as a grave defect It considers that both a university degree and training are essential for secondary school work, and backs its opinion

by the specific statement that the proportion of untrained teachers among the inefficient teachers is very much higher than the proportion of untrained teachers in the service as a whole This opinion is valuable, for it gives added authority to those members of the Colonial Office Advisory Committee on Education who have, for some years past, advocated the provision of professional courses, prior to appointment, for those graduates from British universities who wish to enter the education services in the Colonies A G CHURCH

The Philosophy of Spinoza and Leibniz

The Philosophy of Spinoza The Unity of his Thought By Richard McKeon Pp ix + 345 (New York, London and Toronto Longmans, Green and Co , Ltd , 1928) 25s net

Spinoza By Prof Leon Roth (Leaders of Philosophy Series) Pp xvi + 250 (London Ernest Benn, Ltd , 1929) 12s 6d net

Leibniz By Prof Herbert Wildon Carr (Leaders of Philosophy Series) Pp vi + 222 (London Ernest Benn, Ltd , 1929) 12s 6d net

THE new series of publications which, under the title of "Leaders of Philosophy", is being edited by Prof J L Stocks, ought to supply a want which has long been felt It is true that certain of the volumes contained in Blackwood's "Philosophical Classics", such as Adamson's monograph on "Fichte" and Croom Robertson's on "Hobbes", are in their way unique and of permanent value, but they were written nearly fifty years ago, and the last half century has been particularly fruitful in historical and critical work respecting all the philosophical systems that have influenced western thought There is, therefore, ample room for such a set of volumes as Prof Stocks contemplates, and with those that deal with Spinoza and Leibniz, the two greatest metaphysical thinkers of the pre Kantian period, the new series appropriately makes a start

At first sight, it is true, the individualism of Leibniz would appear to be diametrically antithetical to the universalism of Spinoza But, as Prof Roth points out, when it comes to a detailed working out of the two systems, the opposition tones down, and the similarities are at least as striking as the contrasts Prof Roth instances Leibniz's theories of soul, of pre-established harmony, of liberty, of perfection, as depending on specific features in Spinoza's doctrine, and he refers to the cardinal notion of activity (*esse = agere*) as being already involved in Spinoza's view of modal being He might, however, have gone further, and have shown that in the end both thinkers were confronted with precisely the same crucial issues

Prof Carr's account of the historical background of Leibniz's career, as also of the intellectual world of the last half of the seventeenth century, is extraordinarily well done, and forms a most fitting introduction to the later study In setting forth the various aspects of Leibniz's philosophy, there is room for considerable difference of emphasis, if not of interpretation For, although the philosophy is in itself essentially systematic, yet Leibniz himself left no single systematic exposition of it, and a connected view can only be obtained by drawing together what was put forward in detached letters and papers and essays Prof Carr justly lays stress upon the characteristics of unity and activity as defining for Leibniz the notion of real existence In contradistinction from the discreteness of a physical atom, consisting of *partes extra partes*, the unity of a real existent was the unity of an internal variety, and, in contradistinction from 'moving force', its activity was an 'implanted principle of change and persistence', involving effort, *conatus*, and that without external stimulus In other words, a real existent, or monad, was essentially psychical in character

It was, however, by the help of a further consideration that Leibniz was enabled to advance from this fundamental conception to the thought of an infinite plurality of monads—the consideration, namely, that psychical activity cannot be a mere flowing forth of unimpeded energy, because this would give no more manifestation of itself than would an elastic force which met with no resistance Accordingly, a monad must be both active and passive active, in order to exist at all, passive, in order to exist as an individual and to manifest itself as a centre of activity Hence the existence of one monad presupposed that of a world of monads with which it was in some way in relation, otherwise its unity would be impossible I think it is because Prof Carr makes no reference to the passive side of the monad's nature that Leibniz's philosophy, as he presents it, appears to be even more lacking in coherence than it really is For it was just this element of passivity, of limitation, of finitude, that Leibniz fixed upon to explain the appearance, in the life of the more developed monads, of the phenomenal world of sense experience In so far as the monad is passive, its representations are, he argued, obscure and confused, and what is obscure and confused *seems*

to it foreign, other than itself, *seems*, that is to say, to be external and material In brief, it was owing to the element of passivity in the constitution of the human mind that what is in truth non spatial appears to us as extended All this important side of Leibniz's teaching Prof Carr leaves untouched

The volume by Prof Roth is an able and scholarly piece of work, admirably adapted for those who are beginning the study of Spinoza It is divided into three parts, dealing respectively with Spinoza's life and general outlook, his philosophy, and his place in the history of thought Emphasising the fact that it was primarily as a moralist, bent on ascertaining the true goal of human endeavour, that Spinoza embarked upon metaphysical inquiry, Prof Roth unfolds with singular lucidity and well-balanced judgment the main results of the quest Nothing could be better in their way than the chapters that expound Spinoza's view of human beings as parts of Nature and the three grades which he distinguished of knowledge and conduct Where I think the author has been less successful is in his treatment of the metaphysical foundation of the whole system For bringing out the real significance of the metaphysic, it seems to me to be necessary to take account of the logical method that was being pursued, and, in particular, to be clear that it was with the notion of reason and consequent, and not with that of cause and effect as ordinarily understood, that Spinoza was proceeding Moreover, it is unfortunate, so far as his exposition is concerned, that Prof Roth seems unable to make up his mind as to whether what he calls "a recent gloss", which identifies what Spinoza described as 'extension' with physical energy, is justifiable or no, because the interpretation of the metaphysic depends to a large extent on which of these views is taken

Dr McKeon s book is planned on a more ambitious scale than Prof Roth's, and makes greater demands on the reader It is evidently the work of one who has laboured long and meditated much upon the philosophy which it seeks to exhibit as a unified whole The chapter, for example, on Spinoza's attitude towards experimental science is, in itself, a valuable contribution to Spinoza literature, and the account it contains of the controversy with Boyle ought to remove several prevalent misapprehensions So, too, in treating of Spinoza's doctrine of the passions, and of the function of the intellect in respect to the passions, the author has conscientiously striven to bring out the essential things and to play the part of a faithful expositor Again, however, the least satisfactory portion of the work is that which handles the metaphysic It is true Dr McKeon gives due prominence to the conception, fundamental for Spinoza, that while each finite thing is conditioned to exist and to act by another finite thing, which is its cause, and this again by another, and so on *ad infinitum*, yet all these finite 'modes' depend upon an ultimate ground in such a way that without it they can neither be nor be conceived Unhappily, however, in this context a serious printer s error has been left uncorrected on p 192, which altogether obscures the sense of the important quotation from "Ethics", i 17 But there is no adequate discussion of the notion of Substance, or of the relation of the 'modes' to Substance

In point of fact, it is impossible to make clear the metaphysic of either Spinoza or of Leibniz except by a critical treatment, mere exposition is not enough For the truth is that in the writings of both of them two inconsistent conceptions of infinite or ultimate being are struggling for expression, and the exigencies of their thinking occasion repeated oscillation between these two conceptions Spinoza, working on one hand with the principle *omnis determinatio est negatio*, conceived of Substance as purely indeterminate being, being in respect to which any positive characteristic would infringe its absoluteness, and then Substance was for him simply the unconditioned, that which must be in each particular 'mode', but in which the particular 'mode', *as particular*, could not be contained On the other hand, working with the principle that each finite 'mode' expresses the infinite in a definite and determinate manner, he conceived of Substance as *ens realissimum*, the sum of positive reality, and it is this conception which Dr McKeon and Prof Roth ascribe to him But the two conceptions are obviously incompatible, and, whichever alternative be selected, it is clear that the particularity of finite 'modes' is left without a ground

Similarly in the case of Leibniz On one hand, in accordance with the principle of continuity and with the notion of a graduated scale of existents, God was for him, as Prof Carr explains, the 'supreme Monad', the culminating term in the series of monads, although manifestly the difference between the 'supreme Monad' and any finite monad can no longer be a difference of degree only, as that between the other members of the series had been declared to be On the other hand, however, if each monad is essentially an individual,

and if individuality is dependent on the passive, limiting element, it is evident that God, as *actus purus*, as wholly devoid of passivity, cannot be a member of the series of monads, in the sense in which the term 'monad' had been originally defined For God then becomes what Leibniz himself once said a monad without passivity would be, "a deserter from the general order" Accordingly, we get the theory of a transcendent supramundane deity, who calls the world of monads into existence by an act of will, although what it is that converts the ideas of them in the mind of the deity into actual existents remains, from the necessity of the case, an inexplicable mystery And, indeed, as though conscious of this perplexity, Leibniz is not seldom to be found hinting at yet another view, according to which God is the source of all monads, that proceed from him by "a sort of emanation as we produce our thoughts", and then, while it is true the word is retained, the doctrine of monads would appear to have vanished, and that of *deus sive natura* to have taken its place

In fine, it has to be said that while Leibniz's philosophy undoubtedly contains features which are in advance of anything contained in the "Ethics", features that make for a more concrete conception of the world of existing realities, it proceeds largely by the help of like abstractions, and terminates in difficulties similar in kind to those which beset the path of Spinoza

G DAWES HICKS

Geometry of N Dimensions

An Introduction to the Geometry of N *Dimensions* By Prof D M Y Sommerville Pp xvii + 196 (London Methuen and Co, Ltd, 1929) 10*s* net

IT needs courage to produce a text book on the geometry of N dimensions The subject is not unduly difficult to those who take an interest in it, but most people have deeply seated prejudices which prevent them from taking it seriously into consideration One of the pioneers, Schlafli, in spite of his reputation in other branches of mathematics, failed to secure publication for his valuable memoir on hyperspace, and in fact it did not appear in full until after the author's death and fifty years after it was written

Let us examine the prejudices that are responsible for such obstruction, and consider how far they are justifiable The crudest form of prejudice is what may be called the 'common-sense' opinion that as space cannot have more than three dimensions, any consideration of hyperspace is obviously nonsense This opinion is due to a misapprehension as to the nature of the science of geometry, which certainly started as a form of surveying or 'earth measuring', but even in the time of the ancient Greeks had developed into a semi abstract science, to be deduced from a limited number of definitions and axioms We use the word semi abstract rather than abstract, because in the time of Euclid, and for more than two thousand years after him, it was supposed that the axioms were self evident truths about the real world Only one axiom, that concerning parallels, appeared to fall short of the high standard of the others No one doubted its truth, but it was scarcely self evident Many attempts were made to prove it, but all failed, and at last it was realised that a logical system of geometry (non Euclidean) could be constructed by starting with the denial of the parallel axiom This was the starting point for further progress, and by slow degrees it was recognised that there are an unlimited number of different kinds of geometry, each based on a certain set of axioms, which were really more or less arbitrary assumptions Moreover, the terms used in these geometries, such as straight line and plane, are not really fully defined, all that we know about them is that they are assumed to have the properties stated in the axioms

Geometry, then, is a sort of mental game played with an arbitrary set of rules, and by varying the rules we can get different kinds of geometries By varying only the parallel axiom we get non Euclidean geometry of three dimensions, by varying only another axiom we get Euclidean geometry of four or more dimensions, with which Prof Sommerville's book is concerned Of course we could also vary two or more axioms at once, giving for example non Euclidean geometry of four dimensions

Even when all this is recognised, it is still felt by many that hypergeometry, in spite of its logical self-consistency, is rather an unprofitable subject of discussion, like the medieval schoolmen's topic of how many angels could stand on the point of a pin, which, it should be remembered, had to be argued in strict conformity with the rules of logic from certain assumed premises Many scientific workers cannot escape from the opinion that hypergeometry can have no application to the geometry of the real world and cannot possibly have any application to physics or other branches of science Well, they are wrong Hypergeometry can be employed to discuss the properties of a cubic surface in three

dimensions, just as three dimensional geometry can be employed to discuss the properties of a quartic curve in two dimensions The bitangents of such a curve, as Geiser showed, can with advantage be considered as the projections of lines on a cubic surface Segre and other Italian mathematicians showed how, in an analogous way, a cubic surface can be considered as the projection of a four dimensional configuration

These researches have been brought within reach of English readers by Prof Baker's "Principles of Geometry", vol 4, in which he gives illustrations of the utility in geometry of the consideration of space of higher dimensions, especially of four and five dimensions As for physics, the importance in relativity of one particular kind of non Euclidean geometry (Riemannian) is now widely recognised Beginners in wave mechanics naturally assume that the three dimensions required in Schrödinger's theory of the motion of a single particle are the three dimensions of ordinary space, but as soon as we come to the case of two particles six dimensions are required Possibly this fact is not generally recognised As Eddington remarks, "Schrodinger's theory is now enjoying the full tide of popularity, partly because of intrinsic merit, but also, I suspect, partly because it is the only one of the three that is simple enough to be misunderstood" Many problems in thermodynamics require a number of dimensions (or degrees of freedom) exceeding three Coming to other sciences, R A Fisher's "Statistical Methods for Research Workers", a book addressed to biologists and others, is partly based on a use of the geometry of hyperspace The vagueness in the undefined terms of abstract geometry, which at first appears such a defect, is in fact an advantage, for it enables the science to be applied to entities which are very different from those considered in 'earth measuring'

After so lengthy a justification of the study of hypergeometry, the discussion of the details of Prof Sommerville's treatment must be very brief Of the three main branches of hypergeometry, metrical, projective, and differential, he deals fairly fully with the first and less fully with the second, possibly in view of Baker's treatment mentioned above The third aspect is not dealt with here, presumably because of the full treatment that it has received in connexion with relativity

Prof Sommerville's first four chapters explain the fundamental ideas of incidence, parallelism, perpendicularity, and angles between linear spaces Then follow two chapters on analytical geometry, projective and metrical The remaining four chapters, perhaps the most attractive part of the book, deal with regular figures in hyperspace, corresponding to the ordinary regular solids As a parting word to those who are still afraid that the subject is too abstract, we may mention that there are sixty diagrams and several references to sets of models

H T H PIAGGIO

Scientific Prospecting

Applied Geophysics in the Search for Minerals By Prof A S Eve and Prof D A Keys Pp x + 253 (Cambridge At the University Press, 1929) 12*s* 6*d* net

THE location of mineral deposits and structures associated with the formation of minerals by their deformation of natural and artificial fields of physical force is a comparatively recent branch of geophysics, having its origin mainly in the economic requirements created by the War, and owing much of its development to the methods evolved during the War for the detection of unseen bodies The literature describing the various methods and apparatus used consists mainly of scattered papers in technical journals Notable attempts to coordinate this mass of material have been made by Ambronn, in his book on applied geophysics, translated from the original German by Dr M C Cobb ("Elements of Geophysics", see NATURE, July 13, 1929, p 52), and by the American Society of Mining and Metallurgical Engineers in the symposium "Geophysical Prospecting, 1929" The former work outlines the early history of applied geophysics and is a mine of information on related literature, but is written rather for the specialist than the general reader The latter work is a collection of essentially specialist papers on details of procedure and practical work

In the present work, Profs Eve and Keys have attempted to produce a concise and reasonably detailed text book on applied geophysics, suitable for physicists, geologists, and mining engineers—in short, for all who may in their practical work require a fairly complete knowledge of this subject It may be said that they have most decidedly succeeded in their difficult task They have carefully steered between the dubious imaginativeness of the 'popular' account, and the bleak inhospitality of the 'specialist' exposition, and have produced a sound, well-balanced treatise The engineer or geologist who is not thoroughly familiar with physical principles can yet derive a good working knowledge of these geophysical methods, and obtain a well-reasoned assessment of the relative applicability

of each method to a particular problem On the other hand, no difficulties are shirked, so that the physicist can obtain a correct insight into the basic principles underlying each method, and a satisfactory treatment of the methods and apparatus employed Where he wishes for further enlightenment, he is referred to extant papers written by specialists In this latter respect, however, the bibliographical references are not quite so extensive as could be wished, but further references appear at the end of the book

The first fifteen pages of the volume are devoted to an introduction containing a sketch of the history and principles of geophysical methods as applied to the location of minerals, and reveal the essentially practical outlook of the authors In Chap ii (pp 16-52) magnetic methods are discussed, and a very lucid account presented of the principles and apparatus employed Chap iii (pp 53 111) is concerned with electrical methods, and more particularly with earth resistivity measurements, to which the authors have given especial prominence based on their own field tests Their treatment of the potential methods is rather scanty, and would bear amplification in view of the amount of material available On the other hand, in Chap iv, which deals with electromagnetic methods wherein the variations in the electromagnetic field are measured by means of search coils, the authors have within the scope of 37 pages presented by far the best review of these methods that has yet appeared The vital problem of the elliptic polarisation of the field due to phase differences between the constituent electromagnetic vectors is boldly dealt with Chap v (pp 149 182) details the gravitational method, and, whilst thoroughly sound, would be improved by a few examples of the theoretical effects due to various simple types of structure and more details of quantitative interpretation made possible by consideration of such types Also the possibilities of isogam representation are rather scantily dismissed Seismic methods are discussed in the twenty seven pages of Chap vi, which is somewhat scurvy treatment for a method which has had such success in locating salt domes and other structures Lastly, Chap vii devotes thirty pages to radioactive, geothermal, and other methods which have, as yet, attained little practical value A bibliography and index complete the volume

The only real criticism possible is that the sections dealing with other methods might usefully have been expanded to the same degree as the ones devoted to electrical processes At the same time, the authors are to be heartily congratulated on the extraordinarily concise and attractive presentations of these methods which they have given The book should be invaluable to all interested in applied geophysics, including the specialist, who will turn to it repeatedly, especially when he wishes to readjust his horizon to 'practical politics' The price is very reasonable indeed for such a pioneer work, and the typography and illustrations are excellent This is not a book to lie at rest on the library shelf, but one to be read with enjoyment and then treated as a constant source of reference on all questions on this fascinating subject, which may truly be styled 'the new treasure hunting'

Our Bookshelf

Principles of Experimental Psychology By Prof Henri Piéron Translated by Prof J B Miner (International Library of Psychology, Philosophy and Scientific Method) Pp viii + 190 (London Kegan Paul and Co, Ltd, New York Harcourt, Brace and Co, 1929) 10*s* 6*d* net

Prof Piéron is known to psychologists in Great Britain as carrying on the work of Binet at the laboratory of the Sorbonne, and as the author of numerous monographs, as well as a treatise on thought and the brain, already translated into English In the work now translated, and added to the Library of Psychology and Philosophy, he defines psychology as ' a science of behaviour, of activity, of the co ordinated responses of organisms, considered in their totality" He thus holds a form of behaviourism, but his position is by no means identical with that of J B Watson

With his modified form of behaviourism as his guiding principle, Prof Piéron summarises the work of psychological science as he understands it, and the reader naturally finds that his exposition wears a very different aspect from that of the more orthodox treatise He first discusses reaction processes, affective, perceptive, and intellectual, and then gives valuable sections on levels of activity, and mental stages and types Very good examples of careful statement, based not on mere speculation but on scientific inquiry, are seen in what he has to say about masculine and feminine types, and about that much used but imperfectly understood term 'intelligence' Every page of the book shows, however, that it was well worth translating Only a master could have said so much in so few pages, and said it with such perfect clarity

The New Nature Study By F J Wright Pp 287 + 4 plates (London Thornton Butterworth, Ltd, 1929) 5*s* net

The term 'Nature study', as used by modern educationists, is not a synonym for natural history, or for what is vaguely called the study of Nature The primary concern of Nature study is not with the acquisition of knowledge, but rather with the cultivation of the scientific habit of mind by the logical correlation of natural phenomena The

selection of material suitable for investigation of this kind by young pupils is the teacher's main difficulty, but in practice it has been found that the behaviour of familiar animals and plants lends itself most readily to the method desired

For this reason it is, unfortunately, often supposed that Nature study is a dilute form of natural history, and Mr Wright's attractive book gives some countenance to the idea He frankly refers to the study as a 'hobby', the aim of which is to acquire knowledge The method of study he advocates is 'new' only in being based upon phenological recording It is well that attention should be directed to the great importance of the observational work organised by the Phenological Committee of the Royal Meteorological Society and not the least valuable part of the book is to be found in the appendices on "A History of Phenology" and "Phenology Abroad", which are respectively contributed by Mr J Edmund Clark and Mr I D Margary To phenological observers the book may be recommended as a gossipy, though sententious, guide to the identification of the plants and animals specified by the committee It is to be regretted that the manuscript was not revised by a competent botanist, who would have eliminated references to the petals of the wood anemone and to turnip bulbs, with various other unfortunate slips The volume contains a number of useful diagrams and five photographic illustrations

Enigmas Another Book of Unexplained Facts By Lieut Comdr Rupert T Gould Pp 320 + 8 plates (London Philip Allan and Co, Ltd, 1929) 12*s* 6*d* net

THOSE who have read Commander Gould's "Oddities" will be equally interested in his new book, which consists of a series of essays the object of which is to collect and digest the facts relating to a number of incidents which have not, up to the present, been satisfactorily explained He opens by discussing legendary giants, and sums up against the existence of any race of giants, although admitting that men of unusual tallness have been seen among the Patagonians The "Cry of Memnon", a sound emitted at or near sunrise by an Egyptian statue at intervals during a period of two hundred years is ascribed to unequal expansion of two portions of the stones forming the statue

Legendary longevity is another interesting topic, and it seems well established that Old Parr did really attain a remarkable age In discussing the controversies surrounding the first land sighted by Columbus in the Bahamas, and the various mythical discoveries of a north west passage from the Atlantic to the Pacific, the author is in his element, and is able to bring all his nautical experience to bear on the problem However, the detail is at times wearisome The mysterious ringing of bells is described but left unexplained The book closes with a discussion of the objective reality of the so called canals on Mars, from which it appears that the case for their artificial origin is 'not proven' L J C

Outlines of Zoology By Prof J Arthur Thomson Eighth edition, revised Pp xxviii + 972 (London Oxford University Press, 1929) 21*s* net

EVERY teacher of zoology thinks that, if only he had time, he would write the ideal text book for his students, and not a few have found the time The trouble usually is that so small a public outside the particular school concerned considers the work acceptable But in this most uncertain market Thomson's "Outlines of Zoology", written primarily for students in the Scottish universities, apparently meets some very real demand, for it goes steadily on to its eighth edition and undiminished popularity throughout the country

This book will never completely satisfy the student of comparative anatomy, but such is not its aim The author expressly intends it to be used as an accompaniment to other well known works As such it should be an invaluable member of the small library that even the most impecunious must possess, for in it he may learn to see the organism as a whole and living, and, as he reads, he will find guidance to certain vital aspects of his subject that many of the famous text books of zoology ignore

The present edition is some hundred pages longer than that published in 1921 To meet the needs of the more modern teaching, the author has expanded especially the chapters on function and development, the section on genetics has been increased, and one hundred additional illustrations have been inserted D L M

Chemistry in the Home By Dr J B Firth Pp 246 (London Constable and Co, Ltd, 1929) 5*s* net

THIS book, which is intended especially for housewives, welfare workers, and women teachers, is divided into two sections, the first dealing with the atmosphere, ventilation, water supply, heating, lighting, cleansing materials, disinfectants, and textile fibres, whilst the second is devoted to foodstuffs and beverages The subject matter is of very general interest, but the treatment is inadequate, the style of the writing being rather careless and unattractive Moreover, the title of the book seems badly chosen, since no attempt is made to develop the chemistry of the subject, chemical formulæ and equations being carefully avoided for the sake of "those who have no previous knowledge of chemistry"

The volume contains a highly condensed mass of facts, which are often merely enumerated without being adequately discussed Such technical terms as catalyst, saturated compound, enzyme, alkaloid, casein, etc, are likely to baffle the beginner, who may also be astonished to learn from the table on p 16 that the air from Hyde Park is richer in oxygen than that from other sources The expressions "hydrates of carbon" and "oxyhydrate of lead" are unfortunate, and the description of an amorphous substance in the footnote on p 227 is apparently meaningless Many scientific terms which are used in the text are omitted from the index

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

The Classification of the Primates

IN his letter to NATURE of Jan 25, Dr Tate Regan uses the researches of my colleague, Mr Thornton Carter, as an argument against the validity of the classification of the Primates adopted by Prof J P Hill and myself In particular, he hints at the possibility of a complete dissociation of the Platyrrhine and Catarrhine monkeys, and their diphyletic origin respectively in America from Tarsioids and in Africa from Lemuroids

No one who is aware of the original researches bearing upon the problem, which have been carried on in this department by many investigators during recent years, will expect me to give in detail my reasons for rejecting his iconoclastic suggestion Tate Regan himself seems to overlook the fact that my letter in NATURE of Dec 7, 1929, was a commentary on the Croonian Lecture, in which J P Hill adduced new and decisive corroboration of the classification, graphically expressed in the accompanying diagram (Fig 1), which I have been expounding in NATURE and elsewhere for more than a quarter of a century

The significance of Thornton Carter's brilliant investigation, which Tate Regan has put to such strange uses, is worthy of much fuller study than has hitherto been given to it To economise space and to help in lucid exposition I have set out his results by inserting crosses and spots on the accompanying diagram The Lemurs (that is, the members of the sub order Lemuroidea found in Madagascar, as well as the Eocene fossils, E F L, found in America), and the monkeys and apes of the Old World, have enamel characterised by prisms with even edges and a scanty interprismatic substance In the Lemuroidea found in Africa (Galaginæ) and in Asia (Lorisinæ), the Tarsioidea (both recent and fossil, E F T), and the monkeys of the New World, the enamel prisms have undulating edges and the interprismatic substance is abundant Thornton Carter has emphasised the profound importance of the histological differences for purposes of classification If, however, we accept Tate Regan's reference to "the microstructure of the teeth as of primary importance in the classification of the Primates", and, ignoring all other evidence provided by anatomy, embryology, blood-reactions, and susceptibility to disease, break up the natural group of Pithecoidea into two independent phyla, American and African, we ought also to disrupt the Lemuroidea into two independent groups and exclude the African family Galaginæ and the Asiatic family Lorisinæ from the sub order, which would then be restricted to the Lemurinæ, Indrisinæ, and Cheiromyidæ of Madagascar, with the fossil Lemuroids of America and France

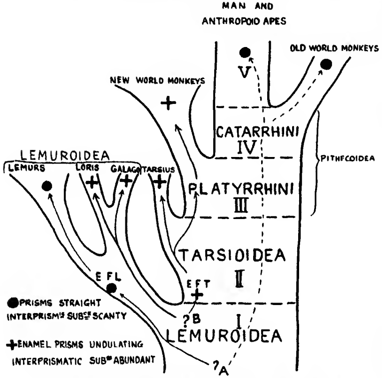

FIG 1 —Subdivision of the order Primates which developed in the Eocene period

The affinities of the Lorisiform Lemuroids, the Tarsioidea, and the Platyrrhine monkeys are admitted by most zoologists — all, in fact, except those who insist upon excluding the Lemuroidea from the Primates The complementary claim, which logically follows if we attach primary and exclusive importance to the evidence of dental histology, that the Mascarene Lemuroids are more nearly akin (than the rest of the Primates) to the monkeys and apes of the Old World, will be repudiated by the vast majority of zoologists, in particular by those mentioned in the foregoing sentence The facts of embryology given in Hill's recent Croonian Lecture, the new researches on the eye and brain, the well known evidence provided by the muscles and skeleton, the reactions of the blood, and in fact every department of comparative anatomy and physiology, go to establish the fact that, in the course of their evolution from remote Lemuroid ancestors, the Catarrhine monkeys must have passed through stages which are now known only in the living Platyrrhine monkeys and the Tarsioidea

The facts of comparative anatomy are fatal to such a classification as Tate Regan adumbrates Perhaps a concrete illustration will make this consideration plainer The outstanding factor in the progressive modification of the Primates is a profound revolution in the structure of the brain to give effect to the growing influence of vision and the transference of optic functions from the mid-brain to the cerebral cortex The morphological effects of this transformation are epitomised in the lateral geniculate body In the ancestors of the Primates the geniculate body consists of two nuclei of approximately equal size, the ventral linking the optic tract with the old optic mechanisms in the mid brain, the dorsal with the new cortical formation In the Tarsioidea, Pithecoidea, and Anthropoidea the growing influence of vision upon behaviour

is expressed anatomically in the expansion and differentiation of the dorsal nucleus, while the ventral nucleus undergoes progressive diminution until eventually it disappears Woollard has shown (*Brain*, vol 49, 1926, p 25) that the enhancement of the biological significance of the eyes in the Lemuroidea (not simply the Lemuridæ, but also the Lorisinæ) is expressed in a hypertrophy of the *ventral* nucleus of the geniculate body while the dorsal nucleus remains insignificant—the direct antithesis of what occurs in the ancestors of the monkeys, which is displayed also in *Tarsius* This is a certain indication of the fact that the Lemuroidea definitely left the track that led to the Tarsioid and Pithecoid conditions

This is merely one example (which might be paralleled by scores of others) to illustrate the impossibility of accepting Tate Regan's suggestion He tells us that he is interested in the subject from " the point of view of a student of geographical distribution " Yet he hints at the possibility of the evolution of the Catarrhines from a Lemuroid in Africa, where the only known Lemuroids (*Galago* and *Perodicticus*) have enamel of the Tarsioid type, that is, lack the very character upon which his speculation has been erected!

The outstanding fact established by Thornton Carter's and Hill's researches is the strength of the links that bind into one closely knit order all five stages in the progressive evolution of the Primates (1) Lemuroidea, (2) Tarsioidea, (3) the Platyrrhine Pithecoidea, (4) the Catarrhine Pithecoidea, and (5) the Anthropoidea

The distinctive characters of the enamel are already developed respectively in the Eocene fossil Lemuroids (E F L) and Tarsioids (E F T) found in America The earliest Eocene fossil Lemuroids (*Pelycodus* and *Notharctus*) reveal the same peculiarities of enamel as are found in the living lemurs of Madagascar The Lemuroids of Africa and Asia reveal the other type of enamel Whether this trait was inherited from some early Eocene (? or Cretaceous) ancestor common to the Loriso Lemuroids and the Tarsioidea (? B in Fig 1) or the common character developed independently in *Tarsius* and the Lemuroid *Galago* (by convergence in the two closely related descendants of one remote ancestor) there is no evidence to prove

Yet the suggestion is illuminating as a possible explanation of the appearance in the monkeys and apes (of the Old World) of the enamel type found elsewhere in the Primates only in the Mascarene Lemuroids If the tendency towards the emergence of this character developed in the remote ancestors of the Primates (? A in Fig 1), shortly before or simultaneously with the contrasted tendency, is it unreasonable to interpret the known facts by the statement that the former was held in check as man's ancestors passed through the Tarsioid and Platyrrhine phases and emerged again only when the Catarrhine phase was reached ?

In his great treatise on the Titanotheres (1914) and elsewhere, Henry Fairfield Osborn has repeatedly directed attention to the fact that in the divergent descendants of a common ancestor, characters which have been omitted in the immediate predecessors may emerge in both lines independently This variety of convergence is really the manifestation of a (previously latent) tendency which is due to a common origin The emergence in the Catarrhines of the type of enamel found in the Lemuroidea may be explained in this way The importance of this character is not diminished by the fact that it was suppressed during the Tarsioid and Platyrrhine phases of Primate evolution Its interest, moreover, is enhanced by the possibility that it may be linked with other properties of the organism Thus Tate Regan's contention seems to receive corroboration from the biometricians In their monograph, " A Study of the Long Bones of the English Skeleton " (1919), Karl Pearson and Julia Bell make the suggestion that the Cebidæ (Platyrrhine monkeys) are derived from a form approximating to the Tarsioidea and " the Simiadæ from a form approximating to the Lemurine group of the Lemuroids " (Sect II, p 314) For the reasons already given this suggestion is untenable Yet it may imply that the peculiarities of the enamel are linked in the evolution of the Primates with the proportions of the femur (and possibly also other features widespread in the whole organism)

The diagram (Fig 1) affords evidence that I have not overlooked the individuality of the Platyrrhine, Catarrhine, and Anthropoid groups, the distinctions no less than the mutual relations of which have been so lucidly expounded in J P Hill's Croonian Lecture

May I remind Tate Regan of what Huxley wrote in 1860 with reference to another pair of Primate groups " It would be no less wrong than absurd to deny the existence of this chasm but it is at least equally wrong and absurd to exaggerate its magnitude, and, resting on the admitted fact of its existence, to refuse to inquire whether it is wide or narrow " (" Man's Place in Nature ")

G ELLIOT SMITH

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University College,
W C 1

The 'Wave-Band' Theory of Wireless Transmission

MY friend Sir Ambrose Fleming raises an interesting question in his admirably clear article on page 92 of NATURE of Jan 18, no less a question than whether a mathematical alternative does or does not invariably correspond with some physical reality I am inclined to think that it does For example, there is some thing rotatory in a magnetic field, and whether the rotation of a plane of polarisation may be properly expressed as an acceleration of one circular component and the retardation of another, we have no better mode of expression until we know more So also I think that a sinuous wave of fluctuating amplitude may be rightly and exactly represented as if it were a band of neighbouring frequencies This is not obvious, but I would remind Sir Ambrose Fleming that the complete solution of the relevant differential equation for forced vibrations contains not only a simply periodic e^{ipt} term, but one with an evanescent exponential amplitude like e^{-kt} as well, and these latter periodic effects—depending as they do on the natural frequency of the receiver circuit (or on its range of possible frequencies)—though they rapidly die away—are of influence at the beginning and end of a wave series Dr Eccles tells me that those initial and final effects are called 'transients' by electrical engineers, and that is a good name for them

If we arrange for hyper selective reception we can deal with a continuous sine wave perfectly, but then it must be continuous, and have neither beginning nor end, and its amplitude throughout must be constant If the amplitude changes, as when a pure carrier wave is fluctuated by a microphone, it is no longer a pure sine curve, and then transient effects must be taken into consideration, for speech depends on those fluctuations of amplitude An excessively sharply tuned receiver working at the top of its peaks, so as to exclude everything except the last trace of a single pure tone, may exclude some of the transient effects also, and therefore not give clear reception Moreover, the amplitude of forced oscillation in the

receiver depends on the tuning, and the equation shows that this must allow for a slight departure from p on either side An alternative and different way of putting it, is to say that the fluctuations of sinuosity may prolong themselves by a sort of loud pedal effect, and cause indistinctness, unless some automatic damper can be applied This might conceivably be possible, by a relayed magnetic field, but mean while I suggest that the easiest way of taking the variations of amplitude into account is to express them as the boundaries of a wave band, to the whole breadth of which the receiver should be competent to respond

I understand from a private letter that Sir Ambrose Fleming intends to put this to the test of experiment, and see if extremely selective tuning which serves for bass notes will be equally effective for the high pitched harmonics essential for clear articulation, and vice versa How wide a band must be to achieve this under customary conditions, I do not know, and I hope he will tell us the result, at present he does not believe in a wave band at all, and his heresy must be of interest to all wireless experts I rather sym pathise with heresy, and hope he can substantiate this one of his, but I am exceedingly doubtful The heterodyne method, of regarding a sinuous dis turbance of fluctuating amplitude as a superposition of pure tones of slightly different frequencies, seems at first artificial, as he says, but it appears to corre spond with experience and if so, it is an interesting justification of the use of a trigonometrical equi valence familiar to many schoolboys, that "the sum of two sines is equal to twice the sine of half the sum into the cosine of half the difference"

OLIVER LODGE

Normanton House,
Lake, Salisbury, Feb 6

MR BEDFORD's letter in NATURE of Feb 8 appears to me to explain the difficulty raised by Sir Ambrose Fleming's article very clearly, but it is perhaps interesting to give the solution he indicates and evaluate the current set up in a receiver of frequency $r/2\pi$ when receiving a wave of frequency $p/2\pi$ modu lated to $q/2\pi$

If we write $p+q=\lambda$, $p-q=\mu$, the equation to be solved to give the disturbance in the receiver tuned to frequency $r/2\pi$ is

$$u+ku+r^2u=\frac{A}{2}\{\sin\lambda t+\sin\mu t\}$$

and the solution is

$$\frac{A}{2}\left\{\frac{\cos\epsilon}{k\lambda}\cos(\lambda t-\epsilon)+\frac{\cos\epsilon'}{k\mu}\cos(\mu t+\epsilon')\right\}$$
$$+Ce^{-\frac{kt}{2}}\sin\left\{\frac{\sqrt{(4r^2-k^2)}t}{2}+\alpha\right\},$$

where $$\cos\epsilon=\frac{k\lambda}{\{(\lambda^2-r^2)^2+k^2\lambda^2\}^{\frac{1}{2}}}$$

and $\cos\epsilon'$ has a similar meaning with μ substituted for λ, while C and α depend on the initial conditions These would normally be $u=u=0$, when $t=0$

Hence if $r^2=\lambda^2=(p+q)^2$,

$$\cos\epsilon=1,\quad \epsilon=0,$$

and the first term in the bracket becomes

$$\frac{1}{k(p+q)}\cos(p+q)t$$

Thus a receiver tuned to a wave of frequency $(p+q)/2\pi$ will be disturbed by the incidence of a wave of frequency $p/2\pi$ modulated to $q/2\pi$, and unless the ratio of the resistance to the inductance of the receiving circuit is large, that is, unless k is large, the disturbance will be considerable

Similarly, if $r=p-q$, a note of frequency $(p-q)/2\pi$ will be reinforced

If r is not equal to λ or μ, disturbances of frequencies $(p+q)/2\pi$ and $(p-q)/2\pi$ will still be produced in the receiver, but the amplitudes will be small

In any event, then, there will be the two side band waves which under favourable conditions will produce large effects R T GLAZEBROOK

Ballards Oak, Limpsfield
Surrey

IN his comments on my letter in NATURE of Feb 8 Sir Ambrose Fleming makes in rather categorical terms some statements that I think he would be in clined to modify if he could give this question a little more consideration I would remind him that an unduly selective receiver most certainly *does* fail to reproduce high notes in their proper proportion The effect is well known and observable at any time by anyone having a receiver in which the reaction is under proper control

I agree that many receivers are insufficiently select ive for practical purposes, but this neither alters the fact that a too highly selective receiver distorts by failing to pick up the side bands nor proves anything with regard to their non existence I would submit, in fact, that theory, laboratory experiment and all practical experience unite in proving that in every sense of the word the side bands do actually exist and that official regulations must necessarily be based on considerations of width of band as well as of amplitude CECIL L FORTESCUE

City and Guilds (Engineering) College,
Exhibition Road, London, S W 7,
Feb 12

THE correspondence in NATURE of Feb 8 (p 198) on the subject of the wave band theory of wireless transmission has directed attention to the question of the physical existence of the so called 'side bands' The following experimental results seem to indicate that these 'side bands' have, in every sense of the word, a very definite physical existence

(1) It is possible to isolate one of the side bands at the transmitting station and to transmit it separately, as in the system of single side band transmission used on the trans Atlantic telephony service

(2) Bown, Martin, and Potter (*Jour Instit Radio Eng*, vol 14, p 57) transmitted a modulated wave, received the carrier and the two side bands separately, and showed that the ionised regions of the atmosphere had treated the three component waves in different ways, as if they were physically distinct It appears that the atmosphere recognises the side bands as separate entities

(3) Rupp (*Zeit fur Physik*, **47**, p 72, 1928) used a modulation method to change the frequency of a light wave, so that it could pass through a selectively absorbing vapour which had stopped the unmodulated wave J A RATCLIFFE

Cavendish Laboratory,
Cambridge, Jan 31

THE correspondence on the existence of the Fourier components of a modulated carrier wave (NATURE, Feb 8, p 198) does not seem to have made the subject quite clear The existence of anything cannot be a mere matter of point of view, neither can the root of the matter be exhibited by the form of the mathe matical treatment necessary

The question at issue seems to be this Will a disturbance in the 'ether' due to modulating a carrier wave affect receiving circuits tuned to the Fourier components of the disturbance (regardless of whether the circuits be damped or not, that is, of low or high selectivity)? Sir Ambrose Fleming says no, in which case their existence is only mathematical fiction

The more orthodox argument seems to be as follows Fourier analysis shows that provided Huygens' principle of superposition holds, a disturbance in the ether due to a modulated carrier wave will be physically indistinguishable as regards amplitude variation from that due to the superposition of sine waves of certain amplitudes and frequencies It follows that circuits tuned to these frequencies will be affected, and therefore they can be said to exist

Since, however, in all reasoning from mathematical equations to the physical world we can never be sure that there are not other factors, not represented in the equations, which may affect the conclusions, we have to resort to experiment The practice of single side band suppressed carrier wave transmission, and the experimental resonant 'humps' referred to by Prof Fortescue, supply sufficient evidence for the existence of the Fourier components The value of Sir Ambrose Fleming's reply depends on whether makers of wireless sets, in their search for greater selectivity, have yet arrived at a point where the response in the audible range varies sufficiently to counteract the advantage gained by excluding interference from other stations

G B BROWN

Physics Department,
University College,
London, W C 1,
Feb 2

The Connexion of Mass with Luminosity for Stars

VERY remarkable and fruitful correlations have in recent years been detected, mainly at Mount Wilson, between the magnitudes of stars and their spectroscopic characteristics The interpretation that would naturally present itself is that magnitude can enter into relation with the radiative phenomena of the surface atmosphere only through the intensity of gravity at the surface, which when great flattens down a steady atmosphere far more than proportionately But if, following Eddington's empirical relation, total radiation of a star is a function of its mass alone, there must be more than this involved, for the radius of the star persists in this relation when expressed in terms of intensities of surface radiation and of gravity, the former determining the temperature roughly by itself Modern hypothesis, which treats confidently of an 'electron gas' with an atomic weight, as Ramsay boldly and prematurely proposed long ago, and subject to the Maxwell Boltzmann exponential energy formula for statistics of distribution, and to its consequences for the theory of dissociation of mixed gases in relation to pressure and temperature, has on the initiative mainly of Saha led to promising applications to stellar atmospheres, which are held to be of densities low enough at any rate not to forbid this mode of treatment

It would seem then to be necessary to conclude that these empirical spectroscopic relations on the surface require that the stellar atmosphere must be dominated to some degree by the remote steady interior of the star Accordingly, tentative theories of the internal constitution of the stars and their flux of radiation have been developed in much detail With Eddington the stars are perfect gases right down to the centre, though the density may there be hundreds of times that of platinum, as has apparently been verified for the case of the companion of Sirius—the high density involving the view at one time not unfamiliar that two atoms can occupy the same space, if the picturesque conception of atoms 'stripped' irrevocably to the bone is to be avoided, and the energy emitted as radiation would come from a dissociation or destruction of matter according to a law involving temperature On the other hand, it is insisted on by Jeans that the necessary radioactivity for the very long evolutions that are contemplated must be of constant and absolute intensity, else the star would explode and he has essayed to regard the star as 'liquid' in his investigations, apparently, however, implying a very imperfect gas rather than a special phase with its surface of sharp transition There are other theories of less statical type

A determined effort to shed off all such special hypotheses has been published very recently by Milne (*Monthly Notices R A S* for November, pp 17 53), which accordingly invites close attention and scrutiny The procedure is the natural one, to try to make continuity between the gases of the atmosphere subject to laws more or less already formulated, and a dense interior about which as little is to be assumed as can be helped He holds that it suffices merely to consider laws of internal density that are in mechanical equilibrium radially under internal pressure P, of which the fraction $(1-\beta)P$ is pressure of the internal field of radiation He does not find it necessary to consider how this field of radiation of pressure $(1-\beta)P$ is sustained against loss by outward flux for if he can arrive at results in terms of surface values that are valid for all such equilibrated densities whether otherwise possible or not, they must hold good for the one that follows the actual law of distribution whatever it may be

The essential feature, so far as a reader can extract the gist from the complication of formulas that seems to be inherent in these discussions, appears to be that the coefficient β, while increasing rapidly downward in the atmosphere in a manner which can be regarded as known, suddenly rises when a photospheric level is reached, altering with steep gradient until a nearly constant value of β is soon attained for the interior of the star and the same must apply only in less degree to the density ρ The condition of mere mechanical equilibrium of the interior is found to express the pressure at the interface between atmosphere and photosphere in terms of values at the centre and one quantity C arising from an integral along the radius involving the arbitrarily assumed law of density The expression for the atmospheric pressure at the interface involves the same constants in such way that on equating the pressures on the two sides of the interface they divide out of the result and only C remains This C is held, in the light unforeseen of comparison with facts, to be in some degree a characteristic constant for all the stars, and thus may be the new element beyond surface values, and without assuming anything about their interiors, that the law as formulated requires

This seems to be right enough in a general way, were it not that the formula for C involves the gradient of density within the star close to the interface, and thus its value must be very substantially changed, in absence of some verification to the contrary, by a very slight radial displacement of the surface which is chosen for that interface For inside the photosphere ρ is as θ^3, while P which is continuous across the interface is as $\theta^4\phi(\theta)$ so C^{-1} is as the value of $P^{-1}(d\rho/dr)^2$ in which the second factor is the internal gradient, at the surface If this consideration be correct it would appear that it is not legitimate to connect the chromosphere with the interior across a

sharp boundary surface, as if they were different phases of matter like a liquid and its vapour This conclusion would involve that the formula itself for C cannot be well founded and the reason can be assigned, that the transition from Milne's formula (21) to (22) is invalid because the interior gradient of ϕ at the interface is very large and cannot be neglected even when multiplied by θ Apparently one can only assert that the mass of the star involves the value of dP/dr within the photosphere and other quantities relating to the centre of the star, and the luminosity involves the value of P outside it, while the pressure P is continuous across a transition but not dP/dr

In any case, perhaps not much stress would be laid on the deduction The formula is regarded probably by its author as essentially an empirical result When the value of C had been adapted to two prominent stars, the Sun and Capella, it turned out in his hands, as he relates, to his astonishment, that it was a universal constant the same for all stars, and if so perhaps not connected with their interior constitutions at all

JOSEPH LARMOR

Cambridge, Jan 18

The Tesla-Luminescent Spectrum of Benzene

IN a recent letter to NATURE (Sept 7, 1929), Shapiro has pointed out that Riemann's wave numbers for the fluorescence spectrum of benzene (*Ann d Phys* **80**, 43, 1926) could be expressed by formulæ of the type

$$\nu = 37494 + 921n' - 998n_1'' - bn_2'',$$

where b takes the values 0, 600, 855, and 1180 in four series and n', n_1'', and n_2'' have appropriate small integral values

It may be of interest to note that similar formulæ hold for the band heads in the emission spectrum of benzene The experimental data were obtained during the tenure of a Commonwealth Fund Fellowship when I collaborated with Dr J B Austin in an investigation of the tesla luminescence spectra of organic compounds at Yale University The experimental method we employed differed in many respects from that of M'Vicker, Stewart, and Marsh (*J C S*, T **123**, 642, 1923) and gave much sharper band heads The error in the wave numbers, which were determined independently by Austin and myself, is probably less than 5 cm $^{-1}$, in the case of the reasonably strong and well defined bands Out of a total of about 110 bands recorded, 87 are satisfactorily accounted for by the formulæ

$$(a)\ \nu = 38613 + 924n' - 161n'' - 994n'''$$
$$(b)\ \nu = 37547 + 924n' - 161n'' - 986n'''$$
$$(c)\ \nu = 36476 + 924n' - 160n'' - 990n''',$$

where n', n'', and n''' have integral values from 0 to 6

It is noteworthy that the bands which are not accurately expressible by these formulæ are, without exception, situated in a part of the spectrum where the bands are faint, and consequently the accuracy of measurement is low It is in general true that the faint bands occur where the quantum numbers are simultaneously large In the most intense system—formula (*b*)—the band represented by the quantum number (0,0,0) is *not* observed faint lines are, however, represented by the numbers (0,0,1) and (0,1,0) The strong band heads in this system begin with an intense band and in approximate agreement with the wave number 37485 given by (1,0,1) This value corresponds to the $\nu_0 = 37494$ given by Henri ("Structure des Molecules", 1925)

There are five vibrational frequencies in the above formulæ, 924, 161, 986, 990, and 994, and these are in approximate agreement with similar constants in previous work on the various spectra of benzene Thus, 921 occurs in Henri's absorption work, and was used by Shapiro in the interpretation of the fluorescence spectrum 163 is a vibrational number employed by Riemann in formulæ for the fluorescence spectrum, and 164 5 occurs throughout M'Vicker, Stewart, and Marsh's work on the emission spectrum Finally, 987 appears in the formulæ of M'Vicker, Stewart, and Marsh, and 998 is given by Shapiro

In his letter to NATURE, Shapiro has directed attention to the agreement between his vibrational frequencies 600, 855, and 1180 and the Raman values 605, 853, and 1176 It may be noted that these numbers can be obtained with considerable accuracy by the combination of the vibrational frequencies in the present work In conclusion, these constants appear to be related to frequencies in the infra red spectrum of benzene, a result which has already been indicated by M'Vicker, Stewart, and Marsh in the case of their constant 164 5

It is hoped to publish elsewhere, in conjunction with Austin, a more detailed account of these results, as well as a description of the experimental investigation, and to extend the work to some benzene homologues for which new experimental data are available

IAN ARMSTRONG BLACK

Physics Laboratory,
The University,
St Andrews,
Jan 23

Gaseous Combustion

IT is interesting to learn, from the letter which in conjunction with Mr W Davies he published in NATURE of Jan 25, that my friend Prof W T David seems to be coming round to an interpretation of his experimental work not unlike, although more advanced than, that which I suggested to him some five years ago as an alternative to the one of 'after burning', as distinguished from 'dissociation', which he had then put forward

Many of those present at the meeting of the Institution of Mechanical Engineers in London on Oct 24, 1924, when a paper by Prof David, on the "Missing Pressure and Heat Losses in Gas Engines" was read and discussed, will recall that he then regarded his work as proving that (to quote his words) "even under the ideal conditions obtainable in a closed vessel some 10 per cent of the gaseous fuel (coal gas) is unburnt at the moment of maximum pressure and that, therefore, incomplete combustion, in addition to increasing specific heat and heat loss, must be regarded as an important factor in limiting the pressure development"

In a written contribution to that discussion (*Proc Inst Mech Eng*, pp 806-9, 1924) I ventured to criticise such conclusion, saying that it was by no means the only possible interpretation of Prof David's experimental results, and that "Other equally probable alternative explanations (as, for instance, the assumption of a different distribution of the total energy, as between vibrational, rotational and kinetic kinds, of steam and carbon dioxide molecules at their moment of formation in the neighbourhood of the maximum pressure from that pertaining to the same molecules when in true equilibrium at the same temperature but at some considerable interval of time after their formation in combustion would equally well satisfy such facts" Also, I said that, so far as I could see, "there was nothing in the results of Prof

David's experiments which would enable them to discriminate at all between the possible alternative explanations Therefore whilst Prof David had preferred the particular interpretation put forward in his paper, he would have been equally justified by his facts in adopting (had he so chosen) another which some might regard as equally or even more probable than his own " In reply Prof David rejected my proffered alternative, because (he said) " the rate of partitioning of energy at the high temperature of explosion must be exceedingly rapid, and thermal equilibrium would set in almost instantaneously "

The alternative view, which I have long held, was further elaborated in the following paragraph on p 202 of the book on " Flame and Combustion in Gases", by Dr D T A Townend and myself in 1927 " When an explosive gaseous medium in equilibrium with its environment is ignited, a very sudden and violent change occurs, whereby new molecules are born at a high temperature in an intensely vibrational condition It is probable that, in the first instance and momentarily, the energy of the newly born molecules is mainly internal, and that a certain time interval must elapse, during which a rapid process of adjustment between the internal and kinetic energies occurs, before the medium re attains a steady state of equilibrium with its environment Indeed, it may be said that, in general, if T be the maximum mean temperature of the medium on explosion, in all probability its ' energy distribution state ' is momentarily different from that which would result had the products of combustion merely been heated up to that temperature In other words, it is generally agreed that the chemical changes occurring in flames and explosions do generate molecular systems whose energy is, in the first instance, largely vibrational, and that a definite, though it may be small, time interval must elapse before the energy becomes mainly kinetic, and the system re attains equilibrium with the environment "

In supposing the formation of 'long lived' molecules of carbon dioxide and steam of 'abnormal structure', Prof David and Mr Davies have extended the foregoing view much further than I would be prepared to go, especially as regards the 'long life' of the supposed metastable molecules Also, in saying that luminosity was manifested in their exploded gases " at a time long after that at which combination (as inferred from the chemical analysis of rapidly cooled samples) has been completed ", they would seem to have modified the former view about the so called 'after burning', in the sense that it seems now to be ascribed to incompleteness of the energy development (because of that held up in the supposed metastable molecules) rather than to that of the actual oxidation itself at the moment of maximum pressure

While reserving any further comments on the matter until after I have studied the evidence adduced in their forthcoming paper, perhaps I may be allowed to put in a caveat that in 'closed vessel' explosions the relative times for complete inflammation, for the attainment of maximum pressure, and for the cessation of luminosity in the medium, so largely depend upon such factors as shape and size of the enclosure and the occurrence of compression waves, that due caution should be exercised in judging the significance of particular experimental data, especially where the vessels used are larger than would allow of substantial homogeneity throughout the medium at the moment of maximum pressure

WILLIAM A BONE
Imperial College of Science and Technology,
London, Feb 10

Dissociation Energy of Oxygen Determined from the Pre-Dissociation of Sulphur Dioxide

THE absorption spectrum of sulphur dioxide vapour, which we are studying with Wieland, is composed of three electronic regions the first 3900 3400 which appears at high pressure (1 atmosphere and more in a tube of 100 cm), the second 3370 2450, which begins to appear at $p = 0\ 1$ mm , and the third from 2350 extending beyond 2000 for low pressures 0 02 10 mm

The first and third regions are made up of series of bands with a fine rotation structure The second region is also made up of bands with fine structure, but between 2550 and 2500 the bands become broad and diffuse The molecule is then pre dissociated

If we assume that this pre dissociation limit corresponds to the reaction

$$SO_2 \rightarrow SO + O$$

the heat of this reaction must be between 111,000 (2550) and 114,000 (2500) calories, the mean value being 112,500 cal

We have studied with F Wolff (*Jour Phys et Rad*, March 1929, p 81) the spectrum of SO, and have calculated from the convergence limit of the normal term the heat of normal dissociation, $SO \rightarrow S + O - 148{,}000$ cal

From the sharp limit of pre dissociation at 2792 which we obtained in the absorption spectrum of S_2 vapour, we can calculate the heat of dissociation of sulphur $S_2 \rightarrow S + S - 102{,}200$ cal This value is in agreement with the thermal determination 103,600 (Budde, *Zeit an Chem* 78, 169, 1912) The heat of reaction $\frac{1}{2}S_2 + O_2 \rightarrow SO_2$ is 83,000 cal (Ferguson)

The heat of dissociation of oxygen is, therefore,

$$148{,}000 + 112{,}000 - \frac{102{,}200}{2} - 83{,}000 = 126{,}400 \text{ cal } (5\ 5 \text{ volt})$$

This value is in good agreement with the determination which we made from the pre dissociation of NO_2 (128,000 cal) (NATURE, Feb 8, p 202)

It is very probable that the third absorption region of SO_2 presents also a pre dissociation limit corresponding to the reaction

$$SO_2 \rightarrow SO + O^*$$

We have found that the energy level of the metastable $1D$ oxygen is equal to 13,700 cm $^{-1}$ (NATURE, Feb 8) The second pre dissociation must then occur between 1800 and 1900 A We are studying it now with the vacuum spectrograph

VICTOR HENRI
Institute of Physical Chemistry,
Zurich

Non-Disjunction Produced by Carbon Dioxide

THE abnormal mitoses seen in tissue cultures kept under high tensions of carbon dioxide were described in a communication in NATURE of Mar 17, 1928, p 420 (see also *Brit J Exp Path*, 9, 240, 1928) Fragmentation of the chromosomes and irregular migration of the chromatin to the centrosomes were seen, exactly similar to the mitotic changes observed many years previously in the eggs of *Ascaris megalocephala* subjected to radium (*Arch Middx Hosp*, 30, 98, 1913) These observations suggested that carbon dioxide might produce hereditary disturbances, when applied to germ cells, analogous to those produced by X-rays and radium In order to test this, observations on non disjunction in *Drosophila* have been made, in which newly hatched virgin red-eyed flies were subjected to either pure carbon dioxide for a few hours,

or to varying mixtures of air and carbon dioxide for longer periods of time They were then crossed with white-eyed males, and allowed to breed

In the experimental series, 9 exceptional sons in 3930 sons were found, in the corresponding controls 2 exceptional sons in 4880 Using the formula given by Karl Pearson (*Phil Mag*, 6th Series, 13, 365, 1907), $\sqrt{\frac{m}{n}(p+1)\left(1+\frac{m}{n}\right)} \times 0\,6745$ equals the probable error of difference, it is calculated that the difference between the mean number of exceptional sons expected from the control series and the actual number of exceptional sons of the carbon dioxide treated flies is equal to 4 66 times the probable error Among the corresponding daughters two *gynandromorphs* were found, both in the experimental series, none in the controls

In view of this effect of carbon dioxide on non disjunction, there is reason to think that it will produce other chromosomal disturbances, and alter germ cells in a manner similar to X rays, and I write in the hope that those who have facilities for the study of the production of mutations will give carbon dioxide a trial For those who are working upon 'the somatic mutation' hypothesis for cancer these results are of special interest, in that they provide a way for the production of somatic mutations other than by X rays and radium J C MOTTRAM

The Radium Institute, London,
Jan 15

Mounting Medium for Film Sections

IN the photomicrography of film sections for the purpose of examining the edge of the section, difficulty is encountered in the case of nitrate base when ordinary benzol- or xylol balsam is used as the mounting medium, owing to the refractive index of the medium being very close to that of nitrate film A mounting medium of high refractive index ($N_D = 1\,591$) suitable for photomicrographing sections of nitrate film is made up as follows

10 cm^3 of alphabromonaphthalene is added to 15 gm of dried Canada balsam in a glass stoppered or 'balsam' bottle The mixture is heated on the water bath until the balsam has melted Gentle agitation will then cause the liquid to become homogeneous

This highly refracting balsam will find other applications in microscopy, for example, for use with Diatomaceæ and micro crystals

For the photomicrography of sections of acetate film, benzol or xylol balsam is satisfactory

EDWIN E JELLEY

Research Laboratory,
Kodak, Ltd, The Works,
Wealdstone, Middlesex, Jan 16

A Probable Band Spectrum of Neon

HERZBERG has recently suggested (*Zs f Phy*, vol 57, p 626) from theoretical considerations that two excited neon atoms may combine to form a neon molecule, just as two excited helium atoms combine to form a molecule of helium, yielding a band spectrum discovered by Goldstein in 1913, and the subject of numerous researches in recent years by Curtis, Dieke, Takamine, Weizel, and others It may be interesting in this connexion to note that while working with a neon discharge tube supplied by Leyboldts Nachfolger, Cologne, I obtained about a year ago a number of bands in the red which appear to be due to neon molecules The bands appeared under a transformer discharge, and disappeared when the discharge was sent from an induction coil

The bands are rather peculiar, as they show no head, and consist of a number of lines at equal frequency intervals Apparently the Q branch is entirely missing, only the P and R branches are developed The bands are approximately at 7393, 7208, 7063, 6963, 6847, and seem to be associated with strong red lines of neon The frequency difference between the successive lines is approximately 6 units, from which the moment of inertia comes out to be 18×10^{-40} cm^{2}gm, and the distance between the neon atoms comes out to be of the order 1×10^{-8} cm The distance between the atoms of the Na_2 molecule is stated by Birge to be $2\,33 \times 10^{-8}$ cm Since the electron in the excited neon comes from a closed shell, its distance from the nucleus should be much less than that of the electron in Na_2, and this is in accordance with my result D G DHAVALE

Department of Physics,
University of Allahabad,
Dec 18, 1929

Preparations of Protozoa and Algæ

WITH reference to Dr Ll Lloyd's method of obtaining preparations of protozoa and algæ (NATURE, Jan 18, p 91), I have used a similar method since 1926 for the study of growths of sessile algæ I demonstrated this method in a paper to Section K (Botany) of the British Association at the Glasgow meeting in 1928

Glass microscope slides 1 inch wide and of the suitable length are fitted in a metal photograph printing frame and either wired (or chained) on the bed of the river or buoyed at a certain level with corks After a given period the frame is lifted out and the slides can be fixed and treated in the same manner as other microscopic preparations

I believe the first to use glass slides for this kind of work was Nauman (see *Ber Deutsch Bot Ges*, 37, 76 78, 1919) R W BUTCHER

The Tees Laboratory,
Barnard Castle,
Durham, Jan 30

Wild Birds and Butterflies

APROPOS of the recent discussion in NATURE as to the frequency with which butterflies are eaten by birds, the following extract from *The Emu*, 29, Pt 3, October 1929, p 88, may be of interest The writer is Mr M S R Sharland, Melbourne, and the species of bird is the dusky wood swallow (*Artamus cyanopterus*) "When almost full fledged they (*i e* the nestlings) were fed at frequent intervals on butterflies This was the first time I had noticed butterflies being included in the menu of either adult or young birds The wood swallow is evidently immune from any objectionable sensations to the palate which the butterfly may cause, but these insects seem to be shunned by most birds" J B CLELAND

The University,
Adelaide, Dec 24, 1929

Insect Pests of Willows

IN a letter in NATURE of Feb 8, p 201, by H P Hutchinson and myself, a serious error in the proof escaped notice *Galerucella luteola* Müll was quoted as a common pest of *Salix triandra* varieties in Great Britain The species, of course, should have been *G lineola* Fabr The former Chrysomelid beetle is common on the Continent and is not indigenous to Great Britain H G H KEARNS

The University,
Bristol

The Function of Phosphate in Alcoholic Fermentation[1]

By Prof ARTHUR HARDEN, F R S

THE discovery that phosphates play an essential part in alcoholic fermentation arose out of an attempt by the late Dr Allan Macfadyen to prepare an anti zymase by injecting Buchner's yeast juice into animals As a necessary preliminary to the study of the effect of the serum of these injected animals on fermentation by yeast juice, the action of normal serum was examined It was thus found that this exerted a two fold effect, in its presence the action of the proteolytic enzymes of the yeast juice was greatly diminished, and at the same time both the rate of fermentation and the total fermentation produced were considerably increased

In the course of experiments made to investigate this phenomenon, which it was thought might have been due to the protection of the enzyme of alcoholic fermentation from proteolysis by means of an anti protease present in the serum, the effect of boiled autolysed yeast juice was tested, it being thought that the presence of the products of proteolysis might also exert an anti proteolytic effect As my colleague Mr Young, who had by this time joined me, and myself had fortunately decided to abandon the gravimetric method chiefly used by Buchner in favour of a volumetric method which permitted almost continuous observations, we were at once struck by the fact that a great but temporary acceleration of the rate of fermentation and an increase in the carbon dioxide evolved proportional to the volume of boiled juice added were produced This was ultimately traced to the presence of two independent factors in the boiled yeast juice, a thermostable dialysable coenzyme, now often known at the suggestion of Euler as co zymase, and inorganic phosphate

With regard to the phosphate, subsequent experiments showed that in all fermentations brought about by preparations obtained from yeast the presence of phosphate is absolutely essential Leaving aside the question of living yeast for consideration later on, three different types of fermentation can be established (Fig 1, curves 1, 2, and 3) with such preparations

(1) A relatively rapid fermentation (Fig 1, curve 1) in which sugar is decomposed into carbon dioxide and alcohol and simultaneously inorganic phosphate is converted into an ester (or esters) of a sugar which accumulates The rate rises to a maximum, and when the supply of inorganic phosphate ceases, the rate of fermentation falls, the accumulation of ester also naturally ceases and the fermentation passes into Type 2

(2) A relatively slow fermentation (Fig 1, curve 2) in which the rate at which fermentation occurs is controlled by the rate at which inorganic phosphate is supplied by the hydrolysis of the phosphoric esters present in the system by the phosphatase also present This inorganic phosphate is alternately reconverted into a sugar phosphoric ester and again liberated by hydrolysis, and thus fermentation proceeds at a steady rate in the presence of available sugar without any permanent increase in the amount of inorganic phosphate or of phosphoric ester present This is the type of fermentation which goes on when sugar is added to an active preparation from yeast and the process is allowed to proceed until a steady rate is obtained In some preparations, depending on the amount of phosphatase present, the rate of fermentation is increased to some extent if more of the sugar phosphoric ester is added or produced (Boyland, *Biochem J*, 23, 219, 1929), but this soon reaches a limit If inorganic phosphate be added, the fermentation passes into Type 1 If sugar fails, inorganic phosphate appears and ultimately (under

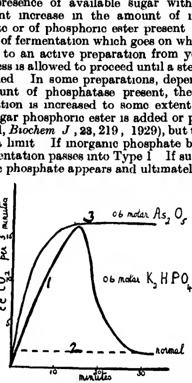

FIG 1

favourable conditions) the whole of the sugar phosphoric ester is hydrolysed, its sugar moiety fermented and the whole of the phosphate liberated in the inorganic form

(3) If now into a fermentation mixture in which a Type 2 fermentation is proceeding an additional quantity be introduced of a phosphatase, capable of hydrolysing the sugar-phosphoric ester and thus increasing the rate of supply of inorganic phosphate (Harden and Macfarlane, unpublished results), the rate of fermentation also rises If a sufficiently active preparation of phosphatase could be added so that the sugar phosphoric ester was decomposed as rapidly as it was formed, a rapid fermentation would ensue, unaccompanied by accumulation of phosphoric ester This has not yet been accomplished directly, but an indirect method of attaining the same end is available, inasmuch as arsenates have been found to have the power of greatly stimulating the effect of the phosphatase

This observation was in reality the undeserved reward for thinking chemically about a biochemical problem In many chemical reactions the type of compound concerned is the main fact of importance, arsenates react like phosphates, potassium may be replaced by sodium, iron by nickel or cobalt Biochemically, the difference between potassium and

[1] Address delivered at Stockholm on Dec 12, 1929, on the occasion of the presentation of the Nobel Prizes.

sodium may be the difference between life and death, and when iron is not used in a respiratory pigment it is not replaced in Nature by nickel or cobalt, but by copper or vanadium So, also, arsenate does not play a similar part to phosphate in fermentation, but acts in an entirely different manner On the addition of a suitable amount of arsenate a rapid fermentation (Fig 1, curve 3) occurs comparable in rate with that of Type 1, but differing from this in that the rate is permanently raised and that no accumulation of the sugar-phosphoric ester occurs Under optimal conditions the addition of inorganic phosphate does not produce any significant rise in this rate of fermentation, as the rate of fermentation is controlled in these circumstances by the concentration of the fermenting complex (enzymes + co-enzyme) Arsenate, on the other hand, does not increase the maximum rate in fermentation of Type 1, as the supply of inorganic phosphate is already optimal

Without making any assumption as to the exact nature of the phosphoric ester actually produced, the changes so far considered may be illustrated by the two equations originally proposed by Harden and Young for the case in which only hexosediphosphate is formed, the first representing the evolution of carbon dioxide and production of alcohol, accompanied by the accumulation of ester, and the second the hydrolysis of this ester with liberation of a hexose and mineral phosphate

$$\text{I} \quad 2C_6H_{12}O_6 + 2Na_2HPO_4 = C_6H_{10}O_4(PO_4Na_2)_2 + 2H_2O + 2CO_2 + 2C_2H_6O$$

$$\text{II} \quad C_6H_{10}O_4(PO_4Na_2)_2 + 2H_2O = C_6H_{12}O_6 + 2Na_2HPO_4$$

Equation I represents the condition of affairs in a fermentation of Type 1, Equation II that in a fermentation of Type 2 In the presence of arsenate, the hydrolysis of hexosephosphate according to Equation II proceeds sufficiently rapidly to supply phosphate at such a rate that Equation I proceeds at maximum velocity

FERMENTATION BY LIVING YEAST

A striking feature of fermentation by yeast preparations is that it proceeds much less rapidly than fermentation by a corresponding amount of living yeast Thus Buchner's yeast juice ferments at only about 1/20 1/40 of the rate of the yeast from which it is derived

The fact that the rate of fermentation of such a juice can be raised in favourable circumstances some ten to twenty times simply by increasing the supply of phosphate seems to me to indicate clearly that a large fraction, at least half, of the fermenting complex of the yeast has escaped injury in the preparation and has passed into the juice, but that the mechanism for the supply of inorganic phosphate has been to a large extent destroyed Neither arsenate nor phosphate has an accelerating action on the rate of fermentation by living yeast This may be due to the fact that the supply of inorganic phosphate in the interior of the yeast cell is already optimal, but some doubt exists as to whether or not these salts freely penetrate the cell If, however, as seems to me probable, it is true that in the making of preparations from yeast it is the phosphate-supplying mechanism that is thrown out of gear, it becomes an object of inquiry in what way this is brought about

Several possibilities present themselves As suggested for the fermenting complex itself by Euler and his colleagues, the phosphatase may in large part be combined with the cytoplasm and thrown out of action when the cell is killed Another possibility is that in the cell the action is localised and that disorganisation of the cell leads to less favourable conditions (for example, concentration, presence of inhibitors, etc) and to lessened rate of action There is some evidence for this, since the amount of phosphatase present, as judged by the normal rate of fermentation (Type 2), seems to diminish as the disorganisation of the cell becomes more complete Thus dried yeast and yeast dehydrated with acetone ferment sugar (Type 2) more rapidly than yeast juice, although when phosphate

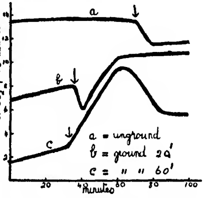

FIG 2

is freely supplied they all cause fermentation at about the same rate Again, some labile substance which acts as an accelerator of the phosphatase may be inactivated by the various modes of treatment (grinding, drying, treatment with toluene or acetone, etc) to which the cell is subjected

The process least likely to activate such an accelerating substance is probably that of Buchner, but the possibility also exists that such a substance, if present, might be adsorbed and thus removed from the juice by the large quantity of kieselguhr employed

Experiments (not yet published) have recently been made in my laboratory by Miss Macfarlane to find out at what stage in the process the change occurs and whether a juice richer in phosphatase could be obtained by modifying the process of grinding and pressing out It appears, however, that simple grinding with sand produces a change of the same order as that observed in Buchner's yeast juice The experiments were made by grinding a mixture of sand and yeast for different times and testing the rate of fermentation and response to phosphate at intervals of the whole mass without pressing out (Fig 2)

These curves show the rate of fermentation of

2 gm of yeast + 2 gm of sand in 20 c c of 10 per cent fructose at 30°, (*a*) without grinding, (*b*) after grinding for 20 minutes, and (*c*) after grinding for 60 minutes At the point marked with an arrow 0 6 c c of 2*M* potassium hydrogen phosphate was added The curves show that the longer the period of grinding, the lower the rate of fermentation and the greater the response to phosphate Here again the total loss of fermenting power was only small

Minor differences were observed when different substances were substituted for the kieselguhr used by Buchner, the most active juice, for example, being obtained by the use of calcium carbonate, whereas barium carbonate yielded totally inactive material Further investigation may possibly throw more light on this aspect of the question

I have assumed up to now that the processes in the living cell are essentially of the same kind as those which occur in the various preparations made from the dead cell, but differ from these mainly in the relative intensity of some of the reactions, and I know no valid argument against this assumption

The cycle undergone by the phosphate in the series of changes which constitutes ordinary fermentation clearly consists in the alternate formation of a phosphoric ester and the hydrolysis of this to free phosphoric acid A simple calculation based on the phosphorus content of living yeast shows that the whole of this phosphate must pass through the stage of phosphoric ester every five or six minutes in order to maintain the normal rate of fermentation, whereas in an average sample of yeast juice the cycle, calculated in the same way, would last nearly two hours

(To be continued)

Hybrid Vigour and Fibre Production

MAN may not consume more vegetable food per capita now than in days past, but it is certain that the amount of vegetable fibre employed to clothe him, and to spread before his eyes the printed word, increases from year to year, and the subject of vegetable sources for our cellulose supplies is frequently canvassed as a result

In a very interesting and suggestive chapter in their text book "Genetics in Relation to Agriculture", Messrs Babcock and Claussen, two distinguished geneticists of the University of California at Berkeley, point out that rapid vegetable growth, in all kinds of plants is frequently very marked in the first generation hybrid offspring of crosses between species or varieties, it is impossible to define the procedure too accurately in view of the confusion that surrounds the taxonomists' definition of a species, but these authors were referring to a familiar phenomenon which very early received attention in the history of breeding experiments

The rapid production of cellulose for the voracious maw of the printing press depends upon the rapid growth of the plant, and in America, following the lead of such geneticists as Babcock and Claussen, the foresters are exploring the possibilities of hybridisation as the source of an F_1 generation of trees which shall grow more quickly than either parent The intention, of course, is to propagate such a vigorous seedling when procured by vegetative means In such a 'clone' of vegetatively propagated trees the hybrid vigour of the original plant may be expected to persist, and when, as in the case of the paper pulp industry, the essential point is quantitative yield of wood, to a certain extent regardless of quality, the problem is relatively clear-cut and there seems considerable possibility of attainment of the practical end in view

Where, however, plants of briefer duration of life are concerned, and where each new generation of plants is raised from seed, at first sight the possibility of obtaining more-vigorously growing plants as the result of hybridisation seems very remote As is well known, in subsequent generations, the Mendelian growth factors, combined in the F_1 hybrid, usually segregate independently and there is little likelihood of many seedlings of the new F_2 generation containing that happy summation of dominant factors contributing to vigorous growth which were fortunately combined by the cross making the F_1 plant However, in recent years numerous cases have come to light where many factors, thus first brought together in a cross, have remained together during subsequent generations as the result of that obscure process controlling the fusion and sorting of the constituents of the chromosome which are grouped under the term 'linkage' It is, therefore, perhaps worth pointing out that at the present time two plants which are or have been under trial as sources of fibre may represent the offspring of a natural hybrid

Prof F W Oliver, now enjoying his well earned rest from the Department of Botany, University College, Gower Street, by taking charge for a short period of the Botanical Department of the University of Cairo, has frequently directed attention to the vigorous growth of one of these plants—rice grass or cord grass, *Spartina Townsendii*

Three articles upon this grass, upon its distribution, its use in reclaiming maritime muds and resisting foreshore erosion, and as a fodder, etc, appeared in the *Journal of the Ministry of Agriculture* recently, and were reprinted by the Ministry as Miscellaneous Publication No 66, whilst, during the War, experiments were made with this plant in paper making As Prof Oliver points out in his contribution in these articles, we are still uncertain of the accuracy of the assumption that this grass arose as a hybrid between the species *S alterniflora* and *S stricta*, experiments made in crossing the putative parents having so far been without result If a hybrid, it is at least remarkable that no segregates have been discovered during the fifty years in which the spread of *S Townsendii* has now been observed

In the other case, the plant in question is under much more vigorous exploitation as a fibre plant 'Brotex' was referred to in NATURE of Mar 9, 1929 Its botanical history is far less known than

that of *Spartina Townsendii*, as its examination has been conducted for commercial rather than scientific ends We are told, however, that this malvaceous plant is a hybrid biennial which comes true to seed and can be grown successfully in Devonshire, with vigorous production of fibre The Brotex Company, of 10 New Burlington Street, London, has issued a booklet containing some very striking photographs of the plant under cultivation at Totnes, Devonshire There seems little doubt also that a valuable fibre can be obtained from the plant, it has still, of course, to establish its place as a commercial source of fibre

Again, we seem to be confronted with a case of vigorous cell wall production by a plant of hybrid origin If the claims for the plant are justified and this vigour of growth maintained in subsequent years, as in the case of *Spartina*, once more the question arises whether linkage has established amongst the hybrid offspring a stable and vigorous race of plants

Another alternative in such cases has to be borne in mind, and will doubtless form the subject of future investigation In *Citrus* and in many other genera of plants, it is possible to maintain a hybrid race intact, although propagating by seed, because these seeds are actually asexually produced, so that though 'seed' is planted, the plants are actually members of one vegetatively propagated 'clone'

The whole subject of the utilisation of hybrid vigour, for fibre production as for fruit and vegetable production in the service of man, is a fascinating topic fraught with great practical possibilities In view, especially, of the utilisation of Britain's tropical resources, it is to be hoped that its investigation will not be left to America, but, on a conservative estimate, twenty times the number of scientific workers are engaged in the study of plant genetics in the United States compared with the number of workers in this field in the British Empire

Obituary

Mr E T Newton, F R S

EDWIN TULLEY NEWTON, who died in London on Jan 28, aged nearly ninety, was for many years a leader in the study of fossils in Great Britain He was born in London in May 1840, and at an early age was apprenticed to a handicraft which gave him special skill in designing and carrying out delicate manipulations He was at the same time deeply interested in natural history, and was fortunate in attracting the notice of Huxley, whose lectures he attended at the Royal School of Mines in Jermyn Street Eventually, in 1865, he became assistant to Huxley, who was then naturalist to the Geological Survey, and henceforth he was able to follow his inclination and devote himself to the study of life, both recent and fossil His official work, however, led to his dealing chiefly with fossils, and in 1882, when Mr Robert Etheridge left for the British Museum, he was appointed palæontologist to the Geological Survey, a position which he occupied until his retirement under the age limit in 1905

Newton's earliest noteworthy success, arising out of his routine duties, was the preparation of the first satisfactory microscope sections of coal, for use by Huxley in a lecture which he delivered at Leeds in 1870, and afterwards published in the *Contemporary Review* These sections aroused much interest, because they revealed masses of spores as the chief constituent of certain bituminous coals, and Newton followed up the subject in his first scientific paper, which was published in the *Geological Magazine* in 1875 Next he turned to the difficult task of preparing a regular series of transverse sections through the brain of a cockroach, which he described, with the aid of his own drawings, in the *Quarterly Journal of Microscopical Science* in 1879 Each of these sections represented a known thickness, and Newton reproduced them exactly on an enlarged scale in a series of plates of soft pinewood He then fixed the wooden plates together in regular order, and thus made a magnified model of the cockroach brain, which he described in the *Journal of the Quekett Microscopical Club* This was one of the first attempts to make a model from serial sections, and it is now preserved in the Museum of the Royal College of Surgeons

Newton's chief official duty as palæontologist to the Geological Survey, like that of his colleague George Sharman, was the preparation of lists of fossils for the memoirs which accompanied the maps Throughout his career, however, he did much more than official routine, and found both time and opportunity to make many important contributions to our knowledge, especially of the fossil Vertebrata His earliest researches of this kind were devoted to the Cretaceous fishes, and he published his results not only in short papers, but also in his well known memoir on the "Cretaceous Chimæroid Fishes", issued by the Geological Survey in 1878, and in the second edition of Dixon's "Geology and Fossils of Sussex", which appeared in the same year

Most of the English Cretaceous fish-remains were fragmentary, and Newton was always fascinated by fragments, which needed special skill and patience for their interpretation He was particularly interested in the scattered remains of the small mammals, birds, and fishes found in the later geological formations, and as the museums of London proved to be deficient in the skeletons of common existing animals which he wanted for comparison, he proceeded to make his own collection He thus brought together a valuable series of exquisitely prepared skeletons, which included parts often neglected, such as the otoliths of fishes Aided by this collection, he made great additions to our knowledge of the vertebrate fauna of Britain which immediately preceded the present, and his services were frequently sought when isolated bones and

teeth were discovered in cave deposits and other comparatively recent geological formations In this connexion may be specially mentioned his Survey memoirs on "The Vertebrata of the Forest Bed Series of Norfolk and Suffolk" (1882) and "The Vertebrata of the Pliocene Deposits of Britain" (1891), also his paper on the Pleistocene vertebrates from the Ightham fissure in Kent contributed to the Geological Society's *Journal* in 1894 He continued such researches at intervals until quite recently, his last paper, on a bone of a pelican from the Yorkshire peat, appearing in *The Naturalist* of June 1928 It may be added that Newton rarely dealt with controversial matters, but his account of a human skull found in a Pleistocene deposit at Galley Hill, Kent, published by the Geological Society in 1895, began a long discussion which still continues

Of all Newton's contributions to vertebrate palæontology, however, the most fundamental were three memoirs on fossil reptiles published in the *Philosophical Transactions* of the Royal Society In 1887, by the delicate preparation of the skull of a pterodactyl from the Upper Lias of Whitby, he gave the first satisfactory description of the brain of a flying reptile In 1893 and 1894, by taking gutta percha casts from the hollows left by the decay of bones which were once buried in the Permo Triassic sandstones of Elgin, Scotland, he utilised in an astonishing manner a most unpromising collection of the remains of various land reptiles, and revealed several skulls and other parts of the skeleton of genera closely related to some previously found only in the Karroo formation of South Africa and in corresponding rocks in India

Although occupied so much with research, Newton still found time to take an active part in the work of scientific societies in London For several periods he was a member of council of the Geological and Palæontographical Societies and of the Geologists' Association He was also a member of the publication and finance committees of the Zoological Society He was president of the Geologists' Association in 1896–98, and president of the Palæontographical Society from 1921 to 1928 He was elected a fellow of the Royal Society in 1893, and received the Lyell Medal from the Geological Society in the same year To his scientific worth was added a charming personality, unassuming and kindly, which leaves happy memories with all who had the good fortune to be associated with him

A S W

SIR GEORGE DANCER THANE

SIR GEORGE THANE died on Jan 14 within four months of the eightieth anniversary of his birth He was associated with University College, London, as student, demonstrator, professor of anatomy, and emeritus professor for more than sixty three years When only twenty years of age, and not yet qualified to practise medicine, he was chosen by Prof George Viner Ellis for the office of demonstrator of anatomy, and seven years later, on Ellis's retirement, Thane was appointed to succeed him in the professorship, which he occupied for forty two years

The mere enumeration of the forty nine years which Thane devoted to the teaching of anatomy at University College represents only one aspect of the great services he rendered Nor did the work or research in, and teaching of, anatomy form the major element in his whole hearted devotion to University College and to anatomy His greatest achievement was his cultivation of a personal knowledge of the students who worked under him, and of a sincere interest in their welfare, which he maintained throughout their subsequent careers He became their lifelong friend Thus his genial personality, and in particular his passion for accuracy in observation and restraint in expressing what he saw, influenced the lives of thousands of medical men and women This played a large part in building up the solid reputation of medical education in London

Thane had a very wide and exact knowledge of anatomical literature Among his contemporaries he was personally acquainted not merely with their published works but also with the men themselves in their laboratories and their social life By his own investigations he acquired the critical instrument for assessing the value of other anatomists' work, and his judgment and power of lucid expression made his own writings a sober and wonderfully accurate picture of the state of anatomical knowledge

Like his predecessors in the chair of anatomy at University College—the men who created "Quain's Anatomy" and made it the standard text book which was adopted as a model throughout the world—he put his best work into this book, rather than into the scientific journals His contributions to the 9th and 10th editions of "Quain's Anatomy" not merely maintained the high qualities and reputation of the work, but also extended its range and precision, and made it the most reliable and adequate text book on the subject that at the time had been produced

Thane was one of the founders of the Anatomical Society of Great Britain and Ireland, and years afterward when he became its president the respect in which he was held abroad was shown by an exceptionally large attendance of distinguished foreign anatomists Thane was an active member of the German and French anatomical societies, and took a delight in attending their meetings, as well as the international anatomical congresses

During his years of service as inspector of experiments on living animals, Thane took a keen interest in acquiring a personal knowledge of physiologists and in facilitating their work He was an honorary D Sc of Dublin and LL D of Edinburgh, and on his retirement from the active work of his professorship a knighthood was conferred upon him in recognition of his public service By his death his former students have lost a wise and kindly friend and the science of anatomy a teacher who unobtrusively did a vast amount of work to establish the foundations of an exact knowledge of the human body

News and Views.

DR. CARL STØRMER, professor of pure mathematics in the University of Oslo, Norway, is shortly visiting Great Britain—for the first time—primarily at the invitation of the University of London. He is known in scientific circles throughout the world as the leading authority on the aurora polaris. His work on this subject has covered a very wide range. On the side of theory he has developed mathematically the ideas first propounded by Kron Birkeland as a result of laboratory experiments on the projection of cathode rays towards a magnetised sphere representing the earth. In a long series of mathematical papers, Størmer has investigated the trajectories of electric corpuscles projected from the sun towards the earth and deflected by the earth's magnetic field; he has shown that numerous observed features of the aurora can thus receive a natural explanation. Many problems connected with auroræ and the associated phenomena of magnetic storms still remain unsolved, but it seems certain that much of Størmer's work will form an integral part of the complete theory when this is arrived at finally.

FURTHER, Størmer is a great pioneer observer of auroræ; he was the first to develop a practical and accurate method of determining the height and situation of auroræ in the atmosphere. Simultaneous photographs of the auroræ are taken, from two or more places connected by telephone, and on plates that also show some of the background of stars, which serve as reference points for direction. The telephonic facilities which he receives in this work from the national authorities in Norway, when an aurora is in progress, afford a remarkable instance of State co-operation in purely scientific research. Among his most important recent discoveries is the fact that the exceptionally high auroral rays, rising to heights of 700 km. or 800 km., are situated in the sunlit atmosphere, though they are viewed after sunset at the place of observation; he has also recently directed attention to the long period radio echoes, which he attributes to reflection by streams of solar corpuscles far from the earth. Prof. Størmer is lecturing in London on Feb. 28, Mar. 5 and 7, mainly on the theory of the aurora, but also on his observations, which he will illustrate with many of his beautiful auroral photographs. He is also visiting the Universities of Oxford, Cambridge, Manchester, Edinburgh, and Aberdeen. It is to be hoped that his visit, particularly to Scotland, will arouse new interest in the observation of auroræ by skilled amateur observers; an international committee, of which he is chairman, has prepared an auroral atlas, and various alternative plans, for use in such observations.

THE British Industries Fair, 1930, was opened on Feb. 17, and will remain open until Feb. 28. The London section is being held this year at Olympia instead of, as formerly, at the White City. The Birmingham section is held, as before, at Castle Bromwich. At London the exhibits cover a wide and diversified range of British manufacture, including—to take only a few examples at random—cutlery, jewellery, glassware, paper, leather, toys, scientific and optical instruments, wireless apparatus, musical instruments, chemicals, and textiles. The exhibits at Birmingham may be described as heavier, since they relate mainly to the iron and metal trades, power (lighting, heating, cooking, and ventilating plant), engineering, railway plant, mining plant, and brewing. While the London section is organised by the Department of Overseas Trade, the Birmingham section is organised by the Chamber of Commerce under the auspices and with the support of the Department of Overseas Trade. It should be noticed that only British manufacturing firms are permitted to exhibit, and that no exhibitor may exhibit articles other than those of his own manufacture. Since the Fair is organised for business and not for show, trade buyers are admitted to the Fair free between 10 A.M. and 8 P.M. on each day. The public are, however, admitted daily on payment between 4 P.M. and 8 P.M., except on Saturday, Feb. 22, when the hours will be 1 P.M. to 8 P.M.

IN order to further the business purpose of the Fair, the Department of Overseas Trade has installed a special office in the Fair where visitors and exhibitors can obtain commercial information on such subjects as tariffs, transport, etc. In addition, there is in each section of the Fair an officer of the Department who is prepared to give information as to conditions in overseas markets, sources of supply, the appointment of suitable agents, and other matters relating to export trade. Besides these facilities the services of interpreters are available free of charge. The British Industries Fair has grown steadily from strength to strength. It is perhaps the one Exhibition which offers, above all others, the greatest opportunity of seeing the latest developments in British manufactures gathered together under one roof—or, rather, under two roofs, one in London and the other in Birmingham. The importance of the Fair at this critical period in the manufacturing industry of Great Britain can scarcely be exaggerated.

AN interesting experiment has been inaugurated in Lanarkshire this week as a result of which ten thousand school children are receiving three quarters of a pint of milk daily until July. The scheme is the most ambitious venture in the realms of physiological research ever attempted in Great Britain. Five thousand children are receiving a ration of raw milk, five thousand are receiving pasteurised milk, and ten thousand will be observed as control subjects. All are being weighed periodically, and elaborate data regarding increase in stature, progress in health, etc., will be compiled at the close of the experiment. The enormous number of children involved in the test will ensure that results will be of so general a character that physiologists will be able to justify the broadest conclusions from them. It is expected by leading Scottish agriculturists that the consumption of milk in Scotland will be greatly increased as a result of the

experiment At present the consumption per head in Scotland is one of the smallest in the world, and an increase would raise the standard of public health in the country

FROM the medical point of view, this experiment in Lanarkshire is equally interesting All milk used is Grade A, guaranteed from herds free from tuberculosis At present almost three thousand cases of tuberculosis are reported every year in Scotland, and if this scheme assists by showing to the people the benefits derived from using the best milk available, then it will to a great extent have justified itself All the arrangements are in the hands of the Lanarkshire Education Authority and its staff of doctors, nurses, and teachers No administrative charges will require to be met, and all the money will be available to provide the milk The cost of the scheme is in the neighbourhood of £9000, of which £5000 has been granted by the Empire Marketing Board and £2000 by the Distress in Mining Areas (Scotland) Fund The remaining £2000 will be provided from a source not yet known The experiment was inaugurated at a meeting in Hamilton Academy on Saturday last, when an address was given by Mr Thomas Johnston, Under Secretary of State for Scotland Several Lanarkshire Members of Parliament also took part, and representatives were present from the West of Scotland Agricultural College, the Hannah Dairy Research Institute, the Scottish Milk Agency, Ltd , and the Farmers' Union Nine hundred gallons of milk are being supplied daily by the Scottish Milk Agency, Ltd

THE composition of the new Economic Advisory Council was announced by the Prime Minister in the House of Commons on Feb 12 Fifteen non Ministerial members have been selected to serve in an advisory capacity, and of these, five represent what may be called the academic side, namely, Mr G D H Cole, Sir Daniel Hall, Sir William Hardy, Mr J M Keynes, and Mr R H Tawney Seven of the members have been drawn from industry and finance, including Sir Arthur Balfour (chairman of the Committee on Industry and Trade), Sir John Cadman, Mr Ernest Debenham, Sir Andrew Duncan, Sir Alfred Lewis, Sir William M'Lintock, and Sir Josiah Stamp Labour organisations are represented by Mr Ernest Bevin and Mr W M Citrine, while Mr W R Blair is representative of the co-operative movement The Ministerial members of the Council, as already announced in the Treasury Minute dated Jan 27, are the Prime Minister (chairman), the Chancellor of the Exchequer, the Lord Privy Seal, the President of the Board of Trade, and the Minister of Agriculture Other Ministers may from time to time be invited by the Prime Minister to participate in the deliberations of the Council, and it has been stated that a number of distinguished industrialists and economists have consented to assist on specific points A whole time staff has also been appointed, consisting of Mr Thomas Jones (secretary), Mr H D Henderson, Mr A F Hemming, Mr H V Hodson, and Mr Colin G Clark

THE appointment of the Economic Advisory Council has recently been the subject of correspondence in the columns of the *Times* In the issue dated Feb 13, 'Econax' pointed out that a vast amount of economic information is already provided by various Government Departments, such as the Board of Trade, the Ministry of Labour, the Ministry of Agriculture and Fisheries, and the Ministry of Transport On the establishment of the Board of Trade there is a chief economic adviser to H M Government who is able to draw upon all the resources of the Board Empire problems of an economic character are already covered by the Imperial Economic Committee, the Imperial Shipping Committee, and the Empire Marketing Board In view of this very exhaustive machinery for the collection of economic data and for advisory purposes, 'Econax' argued that the setting up of an Economic Advisory Council is an innovation which appears to merit more detailed examination by Parliament than it has hitherto received Commenting on this letter, the *Times* stressed the existence of a network of departmental and other bodies created for the very needs which an Economic Advisory Council appears to be designed to supply "Why should the Civil Research Committee or the Melchett Turner Conference be superseded as co ordinating bodies", or if they were not to be superseded, "How was the new Council to supplement their work"? In a reply to 'Econax', Sir William Beveridge claims that some body is necessary to co ordinate the various economic activities of different departments so that the economic life of the country may be seen as a whole by the Government, although he admits that only experience can show if the new machinery will accomplish this object

PROF JULIAN HUXLEY, speaking on the aims of school biology, in an address delivered on Feb 8 to the School Nature Study Union, urged the cultural value of the subject, and deprecated unnecessary technicality in the teaching He pointed out the wide applications of biological principles to purely human, political questions, such as population, eugenics, social and personal hygiene, and so on, and their consequent national importance, and submitted that this consideration justifies the employment of biology as a 'bridge' by which the humanities should be linked with natural science, the easiest bridge being afforded by the history of biology In the course of the address it was shown that many of the facts and principles of chemistry and physics, including mechanics, can be approached and elucidated from the biological side, to mention but a few examples, respiration naturally leads to the chemistry of combustion, nutrition and metabolism to sources, expenditure, and conservation of energy, and also to the theory of solution and osmosis, skeletal structures to the mechanics of levers In actual practice, however, the order of teaching is almost always reversed, the chemical and physical processes exhibited by living organisms being approached through previous study of inanimate objects In view of the fact that Nature study, chiefly of a biological kind, is usually the first stage in science teaching, it is more rational to expand on this foundation in every possible direction so as to embrace the other subjects as

the educational edifice is enlarged, rather than to create a gap, and start the second stage, where definite scientific principles are properly introduced, *de novo* and disconnected from its predecessor

FOR his presidential address to the Optical Society on Feb 13, Mr F Twyman took as his subject "Optics in Radio Transmission and Other Fresh Fields" Optics, which originally meant the science treating of light and the phenomena of vision, has, said Mr Twyman, by general consent come to include the phenomena of infra red and ultra violet radiation The time is now ripe for a further extension to include other radiations, such as those used in radio trans mission and the X rays Not only does the propaga tion of all these radiations follow the same laws, but also the manifestations of them which have become of interest in recent years are often of a nature long familiar to those dealing with optics Furthermore, some of the recent developments have resulted from the application of minds trained in optics to considera tion of these other radiations Illustrations include the polarisation and interference of radio waves, the latter phenomenon enabling the height of the Heavi side layer to be determined, while the use of the notions associated with the diffraction grating have resulted in novel suggestions for radio transmission The 'optical' phenomena of X rays include the forma tion of characteristic spectra of the elements by the use of a crystal in a manner closely analogous to that in which the well known optical spectra are produced by means of a diffraction grating The production of Aston's mass spectra, in which atoms of varying mass are distributed, and photographically register their position in a 'spectrogram', was also dealt with

IN a leading article in the *Engineer* for Feb 14, reference is made to the appointment of Sir Harold Hartley as vice president of the London, Midland and Scottish Railway Co (NATURE, Feb 8, p 213), and to the subject of scientific research on the railways An advisory council of eminent men of science is to be set up under the chairmanship of Sir Harold, and our contemporary asks, among other things, whether the investigations made are to be solely for the benefit of the L M and S R, or whether the results are to be made available for the other companies Collective experiment and collective testing have gone further than collective research, and the question is of greater moment now, as a committee is inquiring into the question of the Department of Scientific and In dustrial Research establishing a locomotive experi mental testing station There are many matters, both technical and economic, connected with the railways that will pay for careful inquiry, and one of the things to be guarded against is unnecessary over-lapping and duplication It is pointed out that the capital invested in the railways of Great Britain amounts to 1211 million pounds, the receipts to 218 millions a year, and the expenditure to 177 millions, and that no fewer than 700,000 persons are employed on them To emphasise the value of research, the *Engineer* recalls the figures given by Mr Garcke at a recent luncheon of the British Electrical and Allied Industries Research Association Research work on insulating oils, he said, has cost £8500 but is saving £100,000 a year, researches on the heating of buried cables has cost £18,500, but has saved the industry at least half a million and added something like four millions to the duration value of the cables

THE movement for establishing scientific and in-dustrial museums in important provincial centres is one worthy of support from all those who have it in their power to further such projects, and it is with interest we learn that the North East Coast Institu tion of Engineers and Shipbuilders is taking active measures for the founding of an engineering museum in Newcastle In a memorandum, the Council of the Institution has given its reasons for so doing and it has now requested the Lord Mayor of Newcastle on Tyne to appoint a fully representative committee for the purpose of establishing the proposed museum As the metropolis of one of the largest industrial districts in Great Britain, Newcastle has cause to be proud of its long list of distinguished shipbuilders and engineers, and with the assistance of the great firms in the district there should be no difficulty in immediately forming a nucleus for such an institution Stephenson, Hawthorn, Armstrong, Swan, Palmer, Tweddell, Noble, and Parsons are but a few of those who, during the past hundred years, have contributed to engineer ing progress, and their names are written large across the annals of the Tyne Stephenson's first locomotives conveyed coal to the river Stephenson's shop in Forth Street was the first locomotive factory in the world, the *John Bowes*, the forerunner of our ocean tramps, was launched on the Tyne, hydraulic cranes and hydraulic tools were introduced there by Arm strong and Tweddell, the turbo generator and the marine steam turbine were brought to perfection there, while in the Tyne built vessels the *Turbinia* and *Maure tania* the river gave birth to two of the most historic ships that ever floated

WHILE engineering and shipbuilding occupy a fore most place among the industries of the north of Eng land, that of coal mining is equally important and its history goes back to the thirteenth century The development of coal mining and transport would alone form an interesting section for an industrial museum But Newcastle is the home of many industries to which science has given birth, as it is also the cultural centre of Northumberland and Durham, which have a population of more than 2,000,000 The museum thus should be not only a place for the preservation of memorials of the past but also an institution with definite educational aims We may perhaps be per mitted to express the hope that the exhibits will be chosen with the greatest care, that each section will be made to illustrate in orderly sequence the out standing improvements of the subject and that it will be borne in mind that a few objects well displayed are generally of greater use to the visitor than more extensive collections It should also be possible, in such a museum, to secure for temporary loan, collec-tions of a similar character to those distributed to local museums by the Victoria and Albert Museum,

and an essential part of the work of the museum should be the provision of occasional lectures both of an elementary character suitable for school classes and of a most advanced nature for the general public. In the development of a local technological museum such as is evidently contemplated, the committee will have many problems to solve; in the museums in London, Munich, and elsewhere, the committee will have much experience to draw on, but it will have at the same time the opportunity of founding a museum which might well become a model for others elsewhere.

The interest of Ur seems inexhaustible. Each report from Mr. Woolley now seems to open up fresh vistas in the development of the early civilisation of Mesopotamia. In the present season, the work of the month of December, which is described in the *Times* of Feb. 11, has revealed material which once more takes the time series back to a date far beyond the hopes of the excavator in this area a few years ago. Continuing excavation in the cemetery area, the expedition, among other discoveries, has found a man's burial with the remains of a wig decorated with gold ear rings and a gold frontlet, thus confirming a suspicion that the Sumerian nobleman was clean shaven and wore a wig on state occasions. The chief interest of the excavation in this area has now, however, been diverted to the huge rubbish mounds in which the graves were dug. Here eight well defined strata have been found. Over the graves is the stratum of the First Dynasty, about 3100 B.C.; below this a layer with slightly earlier seals; then a deep zone in which are nearly all the graves. Below the graves are five further layers containing tablets and seal impressions. It is interesting to notice that in the successive strata a gradual development from naturalism to convention in art is noticeable. Intricate linear designs such as are not known in any later period are sometimes combined with signs from the script. In some cases half the characters are new; in others they are interrupted by pictures, birds, bulls' heads, and the like, which suggest a transition stage between hieroglyphic and linear writing.

The whole series of new finds at Ur is unparalleled in Mesopotamia, so much so that it is suggested a foreign origin might be attributed if it were not for the clearly Sumerian character of other objects. Bulls' hoofs in copper exactly resemble the copper sculptures of the tombs, though more than 20 feet lower down. The stratification of the cemetery is to be closely related with that of the town site, where a second excavation is in progress. Here houses are found built one above the ruins of another. In a depth of 29 feet, eight separate buildings have been unearthed, the fourth of these from the top already older than the royal graves, and the sixth contemporary with the cemetery stratum which produced the bulls' feet and the remarkable seal impressions. In the eighth are splendid examples of the pottery painted in three colours hitherto reported only from Jemdet Nasr, near Kish, and below begin to appear the black and green sherds of the al 'Ubaid type. In this same stratum was found the figure of a wild boar in steatite, the oldest piece of sculpture from Ur.

A film phonograph which plays continuously for two hours has now been invented by Dr. C. W. Hewlett, the engineer to the General Electric Co. of America. A reel of film four hundred feet long but small enough to fit into a coat pocket can reproduce a complete play or opera which otherwise would require at least fifteen twelve-inch disc records. To obtain this result Dr. Hewlett utilises one of the methods used for recording sounds when making 'talkie' films. A jagged line photographed on the edge of the film represents the sound. Light coming from a narrow slit passes through the film into a photoelectric tube. As the teeth of the jagged lines pass by the slit the amount of light reaching the tube is varied and this varies the magnitude of the electric current. This current after amplification actuates a loud speaker and a clear reproduction of the original sound is made. According to the *Science News Letter* of Jan. 25, this 'child of the talkies' heralds the home entertainer of the future. The film has no sequence of photographs and contains only sound records. A continuous loop of film is used, unwinding from the inside as it winds up on the outside. With the present model, there is space for nine separate sound tracks, but this will doubtless be increased. When a track ends, the machine shifts automatically to the next in a fraction of a second, so that there is no practical interruption of the sound. The film runs at a speed of forty-five feet per minute, which is about half the speed at which ordinary talking motion picture films run. So far, no plans have been announced for the commercial development of the film phonograph.

Interest has been taken in Great Britain in gliding since 1896, when Pilcher and Weiss, to mention only two of the pioneers, made their successful experiments. In Germany, because the Peace Treaty made the use of aircraft difficult or impossible for the private owner, the glider was developed scientifically, with the result that an entirely new type of aircraft, the 'sail plane', was evolved. The glider will fly in a strong upward current of air such as is found on the slopes of hills, but it is not capable of extending the flight beyond the limits of this current of air. The 'sail plane', although it requires a moderate upward current of air to start its flight, is able to make use of the very slight upward trend of the air which supports cumulus clouds, the force of gusts of wind, and line squalls, as well as those very slight currents of air that are due to the changes in the reflection of the sun's rays by variations in the surface of the ground. The ability of the 'sail plane' to soar in the same manner as a bird opens fresh possibilities in the field of aeronautics. In Germany the Rhön Rossitten Gesellschaft, and in the United States the National Glider Association Inc., have drawn up regulations to ensure the adequate strength and safety of gliders and 'sail planes'. They issue certificates of airworthiness, approve gliding grounds, and license pilots and instructors for these engineless aircraft. In Great Britain the British Gliding Association, 44A Dover Street, London, W.1, will do the same work; full regulations will be announced at the inaugural

meeting to be held on Mar 27 Lord Wakefield is presenting a cup to the Association, which will be awarded for the most meritorious performance

AT the meeting of the Linnean Society of London on Feb 6, the president, Sir Sidney F Harmer, exhibited a pair of shoe laces, and commented on their zoological interest as illustrating a remarkable characteristic of the Delphinapteridæ This family, the only recent species of which are the white whale (*Delphinapterus leucas*) and the narwhal (*Monodon monoceros*), both Arctic animals, differs from other Cetacea in the structure of the skin The epidermis in this order is normally in immediate contact with the blubber, a thick layer of dermis containing a great quantity of oil or fat In the Delphinapteridæ the epidermis is separated from the blubber by a superficial layer of dermis, which by suitable treatment becomes leather of excellent quality, generally known as 'porpoise leather' The laces exhibited had more elasticity than ordinary leather, and probably were actual products of *D leucas*, as indicated by the designation, 'genuine white whale buckle laces', under which they are being sold The white whale has been captured in limited numbers, during recent years, chiefly by vessels operating from Norway

PROF B BLACKLOCK, of the Liverpool School of Tropical Medicine, delivered a Chadwick Public Lecture on Feb 13, taking as his subject "Health in West Africa" The health problems of the British West African colonies are of growing importance The increase of annual West African trade, from sixteen million pounds in 1907 to sixty million pounds in 1927, has resulted in a large influx of white residents The fall in the death and invaliding rate among Government officials since the beginning of the century has been remarkable For the period 1881–97, the Gold Coast officials had a death rate of more than 75 per 1000 per annum, and Nigerian officials a death-rate of more than 53 per 1000 per annum, for 1928 the death rate for officials over the whole of the West African colonies, including Gambia, Sierra Leone, the Gold Coast, and Nigeria, was only 6 7 per 1000 It would be useful to have similar figures from commercial firms with employees in West Africa The marked improvement in the health of Government officials reflects great credit on the medical and sanitary administration But it was obtained only by the co operation of the total white residents, the European in West African coastal regions can only keep free from disease by meticulous care of himself Even when free from actual sickness, the average European does not feel fit in the West African low lying country, better housing and more suitable recreation, in which the governments might take an official interest, will help to eliminate part of this disability Prof Blacklock then discussed the problem of trying to bring the housing, diet, and general sanitation of the native up to a reasonable standard In West Africa there are under British rule some 25 million natives, and the vast majority of them are remote from medical aid Good work has been done in Sierra Leone in the form of a survey of disease and the construction of good motor roads, but a very great deal can also be done by the education of the native, in his own tongue, in elementary hygiene

THE major contribution in the January number of the *Natural History Magazine* of the British Museum (Natural History) is Dr Rendle's popular account of some of the impressions made upon a botanist by his recent tour with the British Association in South Africa Many naturalists will read with interest also R I Pocock's unravelling of the identity of the 'Nandi bear', an unidentified predatory animal, held in horror by the natives of East Africa (according to themselves), which so far has eluded the white sportsman The skin and skull at last received as the authentic relics of this creature turn out to be, as regards the skin a spotted hyena, and as regards the skull a leopard The entire story of this fabulous beast and the solution prove again the need for the closest and most critical scrutiny of natural history information derived from native sources

THE Royal Air Force is to be congratulated on the distinct success achieved with the first issue of its new journal, the *Royal Air Force Quarterly* The magazine has for its object the promotion and advancement of aeronautics, both in and out of the service, and if the standard of future issues can be kept as high as that attained in the first, so far as quality at any rate is concerned, its success is assured The articles deal, among others, with such diverse questions as operations in the Near and Far East, co operation in the Army and Navy Air Force, air strategy, analysis of leadership, preparation for the Staff College, Trans Jordania, wind structure, metal military aircraft, and high speed flight—clearly a very broad field of view The journal is illustrated by a series of exquisitely produced and valuable photographs and reproductions which reflect great credit on the compilers It is to be hoped that an equally high standard of finish will be maintained in future issues

THE Medical Research Council has appointed Air Vice-Marshal David Munro, on his retirement, as Director of Medical Services, Royal Air Force, to be Secretary of the Industrial Health Research Board in succession to Mr D R Wilson, lately appointed Deputy Chief Inspector of Factories at the Home Office The appointment will take effect on Mar 1

THE following officers and new members of Council of the Royal Astronomical Society were elected at the annual general meeting of the Society on Feb 14 *President* Dr A C D Crommelin, *Treasurer* Mr J H Reynolds, *Secretaries* Prof H Dingle and Dr W M Smart, *Foreign Secretary* Prof H H Turner, *New Members of Council* Dr J A Carroll, Dr J Jackson, Mr B M Peek, and Prof F J M Stratton

SIR WILLIAM BRAGG, Fullerian professor of chemistry in the Royal Institution and director of the Davy Faraday Research Laboratory, has been awarded the Franklin Medal by the Board of Managers of the Franklin Institute, Philadelphia, "In recognition of a life work in the study of X-rays and radio-

activity, in the course of which he made fundamental contributions to that realm of physics, of his development of a method of determining molecular and crystal structure by the reflection of X rays and of his fruitful guidance of the Davy Faraday Research Laboratory and the Royal Institution of Great Britain "

THE High Voltage Research Laboratory of the Metropolitan Vickers Electrical Co, Ltd at Trafford Park, Manchester, will be opened by Sir Ernest Rutherford, President of the Royal Society, on Friday, Feb 28 In recent years the Company has been developing building accommodation, equipment, and staff at Trafford Park to deal satisfactorily with its requirements for investigational work in the whole field of high voltage phenomena The nature of the opening function on Feb 28 will be a short formal ceremony by Sir Ernest Rutherford, followed by some special demonstrations, and an inspection and examination of the detailed equipment in the high voltage laboratory itself, and also in the other laboratories of the Company, covering a wide field of physics, metallurgy, and electrotechnics generally

IN consequence of inquiries respecting psittacosis or parrot fever, the Ministry of Health has issued a memorandum on the subject which should prove useful to medical officers of health and others (Memo 151/Med London H M Stationery Office, price 1d) The characteristics of the disease and the circumstances of its occurrence are described and precautionary measures suggested, and should suspected cases occur the data of importance for investigation are detailed

A NEW (the third) edition of "Studies concerning the Handling of Milk" (*Research Monograph* No 1) has been issued by, and may be obtained from, the Ministry of Agriculture and Fisheries, Whitehall Place, S W 1 (1s net post free) It contains much valuable and detailed information on the factors concerned in the production of clean and wholesome milk

MESSRS W Dawson and Sons, Ltd, Cannon House, Pilgrim Street, E C 4, have just issued a catalogue (N S No 2) of scientific journals, transactions of learned societies, and books relating to travel, topography, ethnology, anthropology, statistics, etc The list is noteworthy for the many sets and long runs of scientific serials and transactions offered for sale—the longest to reach us recently It should be seen by all who wish to fill up gaps in their libraries

WITH the publication of the January number, the *Collection of Czechoslovak Chemical Communications* begins a second volume of this new journal The first volume (reference to articles in which have appeared in NATURE) contained 690 pages In the January number there are papers on adsorption phenomena at a mercury dropping electrode and on the preparation of new sugars in the series of methyl pentoses There is also a bibliography of Czechoslovak chemical publications which have appeared during 1929 in various journals

THE first number has reached us of the *Journal of Dairy Research*, a new periodical published on behalf of the Dairy Research Committee of the Empire Marketing Board and edited by its chairman, Prof Stenhouse Williams The journal is designed to include reviews by specialists of existing knowledge in different aspects of dairying, original contributions to dairy science, and reviews and abstracts of current literature, and is published by the Cambridge University Press in half yearly parts of about 100 pages at the subscription price of 15s per volume of two parts The present number contains a foreword by Lord Passfield, a review monograph by E T Halnan on feeding standards for dairy cows, four original articles, and abstracts and reviews of current literature

MONTHLY summaries of current scientific and technical literature dealing with water supplies, sewage, trade wastes, river pollution and relevant subjects have been prepared during the past two years by the Department of Scientific and Industrial Research These summaries were compiled primarily for the use of the Water Pollution Research Board of the Department, and a limited number of copies were circulated in neostyled form There is evidence that these summaries would be of value to a wider public, and it has been decided, therefore, to issue a monthly publication containing selected abstracts, the first number of which has just been issued as *Summary of Current Literature*, Vol 3, No 1, January 1930 Abstracts Nos 1 119 Water Pollution Research Department of Scientific and Industrial Research (London H M Stationery Office 1s 3d net Annual subs 15s net)

APPLICATIONS are invited for the following appointments, on or before the dates mentioned - A junior lecturer in mathematics at the Royal Military Academy, Woolwich —The Commandant, Royal Military Academy, Woolwich, S E 18 (Feb 28) A lecturer in charge, with good degree in physics and chemistry, and a lecturer in applied science, at the Abertillery Mining and Technical Institute—D Brynmor Morgan, County Hall, Newport, Mon (Feb 28) An assistant lecturer in metallurgy in the University of Birmingham—The Secretary, The University, Birmingham (Mar 3) An assistant lecturer and demonstrator in anatomy in the Faculty of Medicine of the University of Birmingham—The Secretary, The University, Birmingham (Mar 10) A keeper of the Natural History Division of the National Museum, Dublin, and two assistant keepers in the Art and Industrial Division, one assistant in the Irish Antiquities Division, and one assistant in the Natural History Division of the Museum—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (Mar 10) A senior and a junior research assistant under the Animal Diseases Research Association — The Secretary, Animal Diseases Research Association, Moredun Institute, Gilmerton, Edinburgh (Mar 31) A temporary part time mathematics master at Willesden Polytechnic — The Principal, Willesden Polytechnic, Priory Park Road, Kilburn, N W 6

Research Items

Birth- and Death-rates—In an article by Dr C Tietze in the *Eugenics Review* for January last, interesting data regarding the birth and death rates in Germany are given, as well as comparable statistics for England and France Since 1925 the birth rate of England has been less than that of Germany or France England and Germany were nearly equal in 1920, at 25 5 and 25 8 respectively The French rate was then 21 3, but afterwards fell to 18 2 (1928), while Germany was 18 6 and England 16 7 But considering the number of child bearing women, the French birth rate is 10 per cent higher than the German All these diminishing rates are evidently due to wider use of contraceptives and increased abortions Death rates have similarly declined from 26 in Germany and 21 4 in England in the period 1841–45, to 11 6 and 11 7 respectively in 1928 The net reproduction rate is now below zero in western Europe, but of the three countries considered, it is lowest of all in England and highest in France Predicting from such figures, the population of both England and Germany will probably begin to decline in the period 1940–50

Boredom in Industry—Report No 56 of the Industrial Health Research Board is concerned with an investigation into the effects of monotony in work, by Wyatt, Fraser, and Stock Output curves from workers in several industrial processes of a repetitive kind were obtained and these were related to subjective experiences with regard to interest and boredom It is clear that there is considerable individual variation in susceptibility to boredom, although there were very few of the subjects who were seldom or never bored The more intelligent workers were more liable to boredom on repetitive work than the others The effect of boredom was to reduce the rate of work and to increase the variability Boredom was also related to the degree of mechanisation, it was less likely to occur when, (*a*) the work was entirely automatic so that the thoughts could wander to other things, or (*b*) when attention could be entirely concentrated on the work The effects of different methods of remuneration, whether piece rates or time rates, the influence of the group and other complicating factors are also considered The report is described as of a preliminary nature, but the problems raised are so important for industry that it is well that they should be formulated and studied scientifically

Breeding Grounds of Blue Goose—Although the blue goose (*Chen cœrulescens*) is a migrant which is familiar in winter in the United States, where it then inhabits the estuary of the Mississippi River, until now its breeding ground in the Arctic has never been found A great search for this mysterious summer haunt, which was generally thought to be in the northern regions of Canada, has finally been crowned with success The discoverer, J Dewey Soper, in his long drawn out exploration, spent nearly three years in the task and covered about 30,300 miles in all, of which 4000 miles were by dog team and small boat in and about Baffin Island (*Canadian Field Naturalist*, January, p 1, 1930) In June the birds began to enter the breeding area, by June 8 and 9 thousands appeared, but the heaviest influx, which included, besides snow geese and blue geese, also brent and Hutchin's geese, occurred in the middle of the month Even then the nesting ground was difficult to locate, but on June 26 a group of ten nests, eight of them those of blue geese, was found on the tundra near Foxe basin in latitude 65° 30′ N An account is given of the nest and the characters which distinguish the downy young of the blue and lesser snow geese

Growth in Insects—The observations upon the growth and development of some ten species of dragonflies (Odonata), made by Philip P Calvert, have some interesting general results (*Proc Amer Phil Soc*, vol 68, p 227, 1929) The number of moults was found to vary, and therefore moults are not absolute indicators of biological age Nor do they show that rigidity of growth which has been expressed by the Brooke Przibram ratio of 1 25 or 1 26 Ten species of dragonflies were reared from egg to adult, and the ratio of each instar recorded Nine of the species gave a more rapid rate of growth than the ratio demanded, and the ratios from instar to instar were very inconstant The growth factor varies in an irregular way from instar to instar in dragonfly larvæ and in other arthropods, and these variations are not correlated with changes in the character of the food, facts which detract from the value of Brody's comparison of growth in warm blooded and cold blooded animals Adults of insects with complete metamorphosis are usually smaller than their corresponding larval stages, a character exhibited by a few non arthropods But in the great majority of non insectan animals the relationship resembles that in insects with incomplete metamorphosis, where the adults usually exceed in length the larvæ from which they have developed

Arctic Diatoms—Dr D Vito Zanon, S C, in a paper entitled "Diatomee della Baia del Re (Swalbard)" (*Memorie della Pont Accademia delle Scienze Nuovi Lincei*, Serie 2, Volume 12, 1929), describes a number of diatoms from King's Bay on the west coast of Spitsbergen These were collected by Dr P Gianfranceshi during the polar expedition undertaken by General Nobile, and consist mainly of littoral and bottom forms, although a few planktonic species are recorded A full list of arctic diatoms is given and a large number of these were found in the material investigated, besides other forms which are new for that region, several new varieties and one new species, *Denticula nobilei*, which is named after General Nobile Among the planktonic species are *Rhizosolenia hebetata* and four species of *Chœtoceros* which are new Spitsbergen records

Striated Muscle in Liver of Spider—S Maziarski (*Bull Internat Acad Polonaise Sci*, Series B, No 3, 6BII, 1929) describes the occurrence in the liver of spiders (*Tegenaria*, *Araneus*, *Epeira*) of numerous contractile elements in the form of branched transversely striated muscle cells These are disposed on the external face of the basal membrane of the acini of the gland and form a network either by intercrossing or by direct anastomosis of the prolongations of the cells In their form and position these cells correspond with the branched cells which have long been known—under the name of the basket of Boll—in the salivary glands of vertebrates In the latter the branched cells are smooth and are situated on the internal face of the basement membrane The presence in the liver of spiders of cells the muscular nature of which is beyond doubt, homologous with those in the salivary glands of vertebrates, confirms the view that the basket of Boll is contractile The liver of spiders is a diverticulum of the intestine and its glandular follicles, richly branched and anastomosed, open by four or five ducts into the gut The considerable development of

muscular tissue in the liver is, in the author's view, correlated with the double function of this organ. The follicles are lined with two kinds of cells; some are glandular and produce digestive ferments and the other cells absorb the digested material. The muscular tissue is responsible for the transport of material from follicle to follicle.

Wild Cacao.—Two interesting photographs by Prof. G. Stahel, director of the Surinam Agricultural Experiment Station are reproduced in *Kew Bulletin*, No. 1, 1930, which show what is thought to be indigenous, wild cacao growing along the valley of the Mamaboen Kreek, where it is many miles away from any original plantations or even from any Indian village. The plants in this valley were extraordinarily uniform in character and could definitely be identified as belonging to the type *Forastero*. Another point of great interest which has been observed by Prof. Stahel is that on this natural growth of cacao can be found the witch's broom disease, *Marasmius perniciosus*. This disease, which is only known upon cacao, has of recent years made very serious inroads upon the Surinam plantations, which are some 175 kilometres distant from the valley where the native trees grow, on which the disease occurs to a very large extent. The *Kew Bulletin* contains an account by Dr. J. G. Myers of his visit to this locality for native cacao on behalf of the Empire Marketing Board. Dr. Myers had in view the possibility of the biological control of the more important insect pests of cacao in the West Indies. However, the chief insect pests of cacao were not found attacking the wild tree, which seems to suggest that thrips and the cacao beetle have become attracted to cacao, from other wild host plants, since it has come under extensive cultivation.

Soil Science in Sweden.—The recent appearance of the second number of vol. 3 of *Forestry*, the journal of the Society of Foresters of Great Britain, shows that the high level efficiency of the publication is maintained. An interesting paper in this issue is 'Forest Soil Science in Sweden', by G. V. Jacks. Mr. Jacks' paper discusses the position to which the researches in soil science have reached in Sweden since the first serious inquiries were undertaken and the foundations laid by the work of Sveriges Geologiska Undersökning in the middle of last century. Since the beginning of the present century the work has proceeded under the auspices of the Statens Skogsforsöksanstalt, an institute under State control. Prof. Hesselman, who was responsible for assembling the International Congress of Forest Research Stations which met at Stockholm in July last (a description of the proceedings of which is also given in the present issue), is the president and is assisted by Dr. O. Tamm, geologist, and Dr. C. Malmström, botanist. The soil investigations have been mainly carried out with a practical, usually forestry, end in view, but they have involved a great deal of research of a purely scientific value. Mr. Jacks' paper is therefore well worth consideration on both counts.

Rust Recurrence on Indian Wheat.—This subject formed the theme of Prof. K. C. Mehta's presidential address to the Botanical Section of the Indian Science Congress (*Proc. Sixteenth Indian Sci. Congr.*, Madras, 1929), in which he gave a very clear account of the interesting conclusions that follow from his own work upon this subject. It would appear that on the plains, rusts on wheat are only found over a period of three months in each year; the uredospores are then killed by the summer heat and no source of rust infection is left upon the field when the new crop is sown. With each species of wheat rust investigated, the source of reinfection appears to be in the hill country, where the uredospores survive through the critical summer period on self sown plants and tillers. Prof. Mehta's earlier experience upon the overwintering of rusts in England, when working with Mr. F. T. Brooks at Cambridge, may have helped him in reaching this conclusion; his case is stated temperately and clearly and seems to be based upon long and careful observation, involving considerable travelling. Prof. Mehta complains that the progress of this important investigation has been delayed by lack of financial support. This would seem surprising in the case of such an important practical problem. His results suggest that, with financial support, it might be possible to attempt some control of rust dissemination on wheat by attempting the eradication of the rust hosts in some of the hill localities, or controlling more carefully the growth of wheat in regions where the rust is able to overwinter.

Irrigation in India.—Some interesting figures appear in the review for 1927–28 of irrigation in India, published by the Department of Industries and Labour of the Government of India. The monsoon broke about the usual time and its progress was normal, but there was a slight deficiency of rain in many of the plain areas. The total area irrigated in British India by government works of all classes was twenty seven and a half million acres, which amounted to 11.5 per cent of the total area sown. In Sind, the irrigated area was 76.8 per cent of the total area; in the Punjab 35.2 per cent; and in the Madras Presidency 18.6 per cent. In most of the provinces further irrigation works are in progress. Details are given of these and of projects under consideration. One of the most important schemes in hand is the Sukkur barrage on the Indus. Important works are also on hand in the North-West Frontier Province, where drainage works are being constructed to relieve the waterlogged soil of the irrigated areas. This has already resulted in heavier crops and the recultivation of many acres which for long have been lying waste.

Multiple Origin of the Japanese Earthquake of 1923.—Two papers have recently been published on the multiple origin of this earthquake. Prof. A. Imamura (*Tokyo Imp. Acad. Proc.*, vol. 5, pp. 330-33; 1929) shows that the initial portion of the seismogram at Tokyo contains three distinct phases due to movements from different centres. The first came from an origin in Sagami Bay to the north of the island of Oshima, the second 3 seconds later and much stronger from one near Mount Tanzawa, about 18 miles to the north-north-west, and the third and greatest of all, after $4\frac{1}{2}$ seconds more, from a centre about half-way between. Prof. Imamura remarks that the varying directions of the initial motion are explained by the existence of these different centres. He also shows, from a study of the measured changes of level, that faults with noticeable scarps are continued for some miles either as faults or flexures, some of them more than 12 miles in length. Prof. Koto (*Jour. Fac. Sci.*, *Tokyo Imp. Univ.*, vol. 3, pp. 1-21; 1929) refers to the existence of a contributory seismic zone about nine miles to the north of Tokyo along the valley of the old river Ara-kawa. After the earthquake of 1894, he traced a fault track 18 miles in length along this valley, and, after the earthquake of 1923, he mapped a broad destructive area along the same zone.

Geological Structure of New Zealand.—A most valuable paper to students of tectonic geology in general and of New Zealand in particular is contributed by Dr. J. Henderson to the *N.Z. Jour. Sci.*

and Tech, vol 11, Aug 1929 It is illustrated by a map showing the main structural lines, depressions, and lowlands of the islands, and by two large scale maps (prepared by the late Mr P G Morgan), which are not issued with the *Journal* but can be obtained by subscribers from the editor New Zealand is regarded as the shattered crest of two crustal up bowings that meet at right angles in the Taupo region, the earth stresses involved having been active during the late Tertiary Theoretically, the shear zone due to horizontal pressure in the crust should curve upwards from a horizontal sole, reaching the surface as a fracture curved in plan and dipping steeply The block rises vertically in front and rotates on the curved surface on which it rests The original upper surface of the block thus comes to be tilted away from the inner side of the fault trace Many of the faults and blocks of New Zealand show features in close agreement with theory There is good evidence for the following statements (1) The mountain building faults, wherever observed, dip steeply (2) Many of the faults are arcuate in plan (3) Many blocks are back tilted from the bordering fault (4) Many blocks are highest near the central part of the fault (5) Several faults grade into anticlines The north east trending crustal ridge of which New Zealand is the highest part may be considered as the upthrust edge of a gigantic earth block with its frontal scarp overlooking the Tonga Deep Pressure at right angles has raised on this block a number of isolated north west trending ridges, of which the Auckland Peninsula and New Caledonia are ex amples

Elastic and Electric Properties under Pressure —The December issue of the *Proceedings of the American Academy of Arts and Sciences* contains two papers by Prof P W Bridgman of Harvard which continue his long series on the properties of substances under hydrostatic pressures of the order of 12,000 atmo spheres The first shows that, in general, pressure increases the modulus of rigidity of a metal less than 6 per cent per 10,000 atmospheres, and in the case of two rare metals diminishes it slightly In the second, the compressibilities of four single crystals of metals, seven of inorganic and four of organic substances, and lastly of bakelite, are determined The diminution of 1 cm parallel to an axis of a crystal due to a hydro static pressure of 12,000 atmospheres is of the order 1 to 6×10^{-4} cm and varies almost as much from one axis to another in the same crystal, particularly in inorganic crystals The electrical resistances of indium, manganese, chromium, and arsenic all de crease with increase of pressure and are thus normal, while arsenic appears to undergo a modification of form at 5500 atmospheres

Properties of Ammonia —The thermodynamic properties of ammonia are of considerable importance in connexion with its use in refrigeration In the January number of the *Journal of the American Chemical Society*, Beattie and Lawrence deal with these properties and describe experiments on the com pressibility of gaseous ammonia and the vapour pressures of liquid ammonia from 30° to 132° An equation of state for the gas is derived from the first set of experiments, the vapour pressures are in agreement with those found by the U S Bureau of Standards and by Keyes and Brownlee

Combustion of Charcoal —The nature of the chemical reactions involved in the combustion of charcoal has long been a matter of investigation and dispute The theory usually accepted at present is that put forward by Rhead and Wheeler in 1912 on the basis of experiments, namely, that the oxygen is first attached to the carbon in the form of a loosely formed complex, C_xO_y, which at higher temperatures decomposes into carbon monoxide and dioxide The view that the oxygen is adsorbed is also tenable, especially since Langmuir has identified the forces holding adsorbed molecules on surfaces as primary or residual valency forces of the atoms composing the surface The fact that the adsorbed oxygen cannot be removed as such by reducing the pressure, and appears to be firmly bound, is better explained by Rhead and Wheeler's theory, although Richardson in 1917 could find no evidence of a complex oxide in the study of the reverse action of carbon dioxide on char coal at relatively high pressures In the December number of the *Journal of the Chemical Society*, M S Shah describes experiments on the combustion of charcoal in oxygen, nitrous oxide, and nitric oxide It is well known that brightly burning charcoal burns more brilliantly in nitrous oxide than in air, but does not continue to burn in nitric oxide, although the latter contains more oxygen He considers this anomalous, although it is usually explained by the undoubtedly greater thermal stability of nitric oxide The main result of the work is that the initial stage in all three cases seems to be due to fixation of oxygen Charcoal retains nitric oxide as well as oxygen, re action then proceeds between the charcoal and the fixed gases, and the ultimate products are carbon dioxide and nitrogen Even in a rapid stream of gas no carbon monoxide was detected, whilst with oxygen and nitrous oxide both monoxide and dioxide were formed Shah prefers Langmuir's adsorption theory to the chemical complex theory of Rhead and Wheeler, and shows how, when suitably modified, it is capable of explaining his results

Power Measurement in an Alternating Current Circuit —One of the most difficult problems which electrical engineers have to solve is the measurement of the power in an alternating current circuit The measurement of direct current power is easy, one has merely to measure the current and the pressure and multiply them together This can be done by a single instrument called a wattmeter, which can be calibrated with a maximum inaccuracy of about the tenth of one per cent Wattmeters suitable for measuring alter nating power at high voltage when the current is large are much more difficult to construct In calibrating the instrument, not only have the current and the voltage to be measured but also the difference of phase between them The mean power is the product of the voltage and the current into the cosine of the phase difference As transformers have to be used to reduce the pressure and voltage to values which can be measured by voltmeters and ammeters, the trans forming ratios of these devices have to be very accur ately determined As the power to be measured is far larger than any available in a testing laboratory, artificial 'loads' for the meters have to be made up, the voltage coil being actuated by one circuit and the ampere coil being actuated by another, the circuits being arranged so that the phase difference between the currents flowing in them can be accurately calcu lated At the Institution of Electrical Engineers on Feb 7, three papers dealing with this problem were read The first paper, by G F Shotter, described a null method of testing instrument transformers The second paper, by R S J Spilsbury and Dr Arnold of the National Physical Laboratory, described the accessory apparatus required for the precise measure ment of large currents In the third paper Dr Arnold described a rapid and accurate method of testing current transformers by means of a potential divider bridge

History of Medicine.

TWO interesting lectures connected with the history of medicine were delivered at the Wellcome Medical Historical Museum at the end of last month by Sir William Willcox and Dr A P Cawadias respectively The former, who chose the subject of secret poisoning for his address, stated that the recent excavations in Mesopotamia have shown that an interest in poisons could be traced back to about 4500 B C, when a goddess named Gula was worshipped by the Sumerians under the name of The Mistress of Charms and Spells and Controller of Noxious Poisons The first scientific student of poisons, however, appears to have been Mithridates king of Pontus, who not only conducted toxicological experiments on condemned criminals and others, but also wrote a book on the subject and invented a universal antidote which according to Celsus, consisted of thirty six ingredients It is recorded that when he wished to commit suicide by poison, rather than surrender to the Roman invader, his constitution had become so inured to various poisons that his attempt was unsuccessful and he had to ask a mercenary to dispatch him with a sword His name survives in modern scientific nomenclature, in the term 'mithridatism', which signifies immunity to poisons, bacterial and otherwise, acquired by gradually increasing doses of the poison itself

During the Roman Empire, Agrippina and her son Nero made elaborate studies in experimental toxicology on the human subject, and by the knowledge thus obtained successfully removed the persons who incurred their disfavour In the course of the next thousand years, poisoning was extensively practised without, however, any great developments taking place in the science of toxicology, and it was not until the time of the Italian Renaissance that an intensive study of poisons was made, the most notorious experts in this field being Pope Alexander VI and his son Cæsar Borgia

Until modern times, the methods of detection of poisons depended mainly on the circumstances attending their administration Nothing was really known about the post mortem appearances, and toxicology did not make any great advance until the development of modern chemistry and its application to the analytical problems with which toxicology is concerned While the only certain sign of poisoning is the identification by analysis of the poison in the body, of recent years so much progress has been made in morbid anatomy and histology that the post mortem appearances often indicate the poison responsible for death apart from its detection in the body by chemical analysis In conclusion, Sir William Willcox illustrated his address by the exhibition of curious poisons and their antidotes from the museum

Dr Cawadias, whose address was entitled "From Epidaurus to Galen The Principal Currents of Greek Medical Thought", maintained that rational medicine was invented by the Greeks and that before their time the general attitude towards disease was irrational, medicine being essentially religious and magical in character Although faith healing was an important feature in the cult of Æsculapius at Epidaurus, it was limited to special cases of non organic disease, and was free from the mystic element of the religious medicine of the ancient peoples of the East Every period of ancient Greek medicine, of which five can be distinguished, is based on the physiological work of the ancient Ionian natural philosophers such as Thales and Anaximander

In the first period, which included the seventh, sixth, and early fifth centuries B C, a method of diagnosis based on physiological considerations with very elementary clinical control was elaborated together with rules for diet and gymnastics In the second period, which included the fifth and fourth centuries B C, Greek medicine became based on more precise physiological knowledge gained mainly by the researches of Anaxagoras of Clazomenæ, Democritus of Abdera, and Diogenes of Apollonia The general mechanism of disease was explained more precisely by the doctrines of Hippocrates Clinical medicine reached its zenith through the method of nosographical diagnosis developed by the Cnidians as well as by the method of personal diagnosis devised by Hippocrates and the school of Cos

The doctrines of the third period, which included the last three centuries B C and the first two centuries A D, were based on the physiological works of Aristotle and marked a very great advance in the knowledge of the functions of the various organs This physiological work was supplemented by the Alexandrian physicians Herophilus and Erasistratus Numerous medical schools flourished during this period While the Alexandrians of the third century B C controlled research in physiology by a strict clinical examination, the Methodists and Pneumatists made physiology the sole basis of diagnosis and neglected the clinical method The Empirics, on the other hand, confined themselves to clinical considerations and refused to consider any diagnostic method connected with the physiological mechanism of disease

The fourth period of Greek medicine is represented by Galen alone (A D 130–200), whose physiological work marked an enormous advance on that of Aristotle owing to the introduction of the experimental method The fifth and last phase of Greek medicine was a period of compilation and transmission, the principal compilers being Cælius Aurelianus (A D 400), Oribasius (A D 326–403), Alexander of Tralles (A D 525–605), and Paulus of Ægina (A D 600–650) Their compilations were used by the Nestorian monks, who transmitted Greek medicine in the sixth and seventh centuries to the Arabians and through them in a slight degree to western Europe The transmission of Greek medicine, however, was mainly due to the Greek scholars of the fifteenth century, who had left Greece after its conquest by the Turks

Cotton in Africa

THE report of the executive committee of the Empire Cotton Growing Corporation to the meeting of the administrative council, held in Manchester on Jan 21 last, contains several important scientific observations on the growth of cotton in Africa

The diseases and pests which attack the cotton plant are many, and each locality has its particular problems to solve in breeding resistant strains Cotton growing in South Africa has suffered from attacks by the jassid insect, and it is interesting to note that a strain has been isolated which is resistant to this pest The new strain of cotton is giving high yields, which is of primary importance to the grower, and recent experience has shown that it is capable of giving good crops in districts with a seasonal rainfall of 10 inches, whereas it is generally considered that a minimum of 20 inches is necessary for cotton

growing In Uganda, one of the most promising cotton growing regions in South Africa, there are good prospects of increased yields, and steps are being taken to ensure this by instructing the native growers in improved methods of cultivation, and by effectively controlling the seed supply

The cottons which the Corporation is cultivating in South Africa are of the American type, and are intended to provide the Empire with sources of supply other than America It is to the Anglo Egyptian Sudan that we have to look for the supply of the better quality cottons of the Egyptian type The Sudan is now producing an increasing quantity of cotton which is almost indistinguishable from the best qualities of long staple Egyptian cotton Recently the disease known as leaf curl has been attacking the crops in this locality, and there is evidence that the jassid insect is responsible for spreading the contagion The Corporation is now considering the desirability of breeding jassid resistant strains in the Sudan

The Corporation, during the first years of its activities, found difficulty in obtaining agricultural scientific officers of adequate experience, but it is pleasing to note that it is now able to arrange for its senior officers to visit cotton growing localities outside their own charge Much good is expected of this interchange of thought and knowledge born of long experience, and the scheme should stimulate the younger officers who are striving to make head way in recently opened cotton growing areas

It is unfortunate that the continued depression in the cotton industry has made it necessary to reduce the spinners' levy from 3d to 1d per 500 lb of raw cotton, but the Corporation will be able to carry out its full programme for the coming year by drawing on its accumulated reserves The burden on the Corporation has been reduced in recent years by the increasing share that colonial governments are now taking in the cost of developing cotton growing, and also because the Colonial Office is now training men for agricultural appointments on the lines initiated by the Corporation F P S

Meteorological Conditions accompanying a Waterspout

AT 9 31 A M, on June 14, 1929, a waterspout formed over Pensacola Bay, Florida, three hours after Lieut P G Hale of the U S Navy had obtained accurate records of the pressure, temperature, and humidity of the atmosphere up to a height of 3000 metres close to the place where the spout developed Mr Hale also secured an admirable photograph of the phenomenon, taken from an aeroplane, which shows that the spout took the usual form of a sharply defined cord like cloud stretching in a rather sinuous curve from the base of a cumulo nimbus cloud to the sea, with a cloud of spray at its base

At the time of the sounding, there was a dust horizon to the east at a height of about 2800 metres, and tall cumulus clouds were thrusting their heads through the haze top Additional evidence of atmospheric instability was furnished by the graph of temperature and entropy plotted on a Shaw 'tephigram', which is reproduced together with the photograph in a short article in the *Monthly Weather Review* for August 1929 The article is of especial interest, owing to the attention directed to the subject by Wegener's recent introduction of the theory that the visible part of a waterspout is the extension of a whirl with a horizontal axis within the parent cumulo nimbus cloud, and also because the chances are so against an aerial sounding happening to be made such a short time before the occurrence of a spout

The 'tephigram' reveals an atmospheric environment such that a very moderate amount of general heating of the lower layers of the atmosphere, or, alternatively, a slight increase of their water vapour near the surface, would allow any portion of the surface air with a little extra warmth or moisture to ascend automatically It shows, further, that the ascending air would have possessed a large amount of surplus energy beyond that required merely for its ascent, such energy being available for developing the kinetic energy corresponding with the violent winds around the axis of a waterspout This is the kind of information that a glance at the 'tephigram' will reveal to anyone familiar with it

When we read that the construction of a 'tephigram' is a matter of daily routine for weather forecasting at the Pensacola air station, it becomes clear that the thermodynamical researches of Carnot, Clausius, Maxwell, and others are beginning - mainly owing to Von Bezold in Germany and Napier Shaw in Great Britain—to have novel fields of practical application

University and Educational Intelligence

BIRMINGHAM —The annual meeting of the Court of Governors of the University is to be held on Feb 27, and the reports of the Vice Chancellor and the Council, which are to be presented to the Court, have been issued The Vice Chancellor, Sir Charles Grant Robertson, reviews the changes which have occurred during the ten years of his tenure of office and is able to report much progress The income and expenditure have greatly increased, and it is satisfactory to note that the largest item of expenditure is that of salaries Nine members of the non professional staff have been promoted to Grade I with a minimum salary of £600 a year—a reform long overdue The number of students continues to increase slowly

The eighth annual report of the Joint Standing Committee for Research shows an imposing array of subjects of research in aid of which grants have been made, and enumerates the publications of the various departments of the faculties of science, arts, medicine, commerce, and law The report indicates a healthy activity in research over a wide range of subjects

The event of the greatest moment to the University is the development of the new hospital scheme, in which an important step has been taken in the selection of plans for the buildings If the money is forthcoming (£1,000,000 has been mentioned) a magnificent group of buildings will arise, on a site near to the University grounds, to accommodate the hospital and the University Medical School

CAMBRIDGE —Mr W R Dean, of Trinity College, has been appointed University lecturer in mathematics

LONDON —The Court of the University has gratefully accepted a bequest by the late Lady Durning Lawrence of £10,000 for the equipment of the Physical and Electrical Chemistry Laboratory at University College

NOTICE is given by the University of Wales that five fellowships, each of the annual value of £200 and tenable for two years, are to be awarded during the present year to graduates of the University Applications for the fellowships should be sent by June 1 to the Registrar, University Registry, Cathays Park, Cardiff

Historic Natural Events

Feb 23, 1887 Earthquake—The Riviera earthquake was not one of great strength, for only 640 persons were killed, while the area disturbed contained 219,000 sq miles The earthquake is, however, interesting on two accounts It was one of the early earthquakes in which the existence of two foci was recognised It was also one of the first to be registered by instruments far beyond the disturbed area, magnetographs being displaced at Kew, Wilhelmshaven, and Lisbon, which are respectively 652, 690, and 951 miles from the epicentre

Feb 24, 1575 Flood of Flies and Beetles—According to Holinshed, at Tewkesbury, "after a flood which was not great, but such as thereby the meadows near adjoining were covered with water, in the afternoon there came down the river of Severn great numbers of flies and beetles, such as in summer evenings use to strike men in the face, in great heaps, a foot thick above the water, so that to credible men's judgments there were seen, within a pair of butt's length, of those flies above a hundred quarters The mills thereabouts were dammed up with them for the space of four days after, and then were cleansed by digging them out with shovels From whence they came is yet unknown, but the day was cold and a hard frost"

Feb 24, 1844 Mild Winter—"I tell you that we have had the mildest winter known The extraordinary fine season has killed heaps of people with influenza, debilitated others for their lives long, worried everybody with colds, etc"—FITZGERALD

Feb 26, 1658 Severe Winter—The winter of 1657–8 was very rigorous On Feb 26 Charles X of Sweden crossed from Fuenen to Zealand across the ice, with all his army, cavalry, artillery, and baggage The ports of Ostend and Sluys were blocked by ice, and even in Italy the rivers were frozen so solidly that they supported the heaviest carriages In Rome at the beginning of February was the greatest snowfall of the century The Seine was frozen, and the thaw was followed by a flood on Feb 27–28, greater than any previously recorded In England the cold was severe, with persistent northerly and northeasterly winds On Mar 7, Evelyn wrote "This had been the severest winter that any man alive had known in England" Spring appears also to have been backward, for on June 12 he wrote "The season as cold as winter, the wind northerly near six months"

Feb 26–27, 1903 Gale—On the night of Feb 26 and the morning of Feb 27 a deep barometric depression travelled north eastwards across the British Isles The barometer fell below 958 mb (28 3 inches) and the winds reached nearly 90 miles per hour in squalls The south westerly gale over Ireland was described as the most violent since the 'big wind' of Jan 6, 1839, thousands of trees were uprooted and much damage was done to buildings On Leven Viaduct, near Ulverston, a train consisting of ten passenger coaches and vans was overturned by the force of the wind

Feb 28, 1540 Beginning of Great Drought—The year 1540 was extremely hot and dry both in England and in central Europe, probably the hottest on record and comparable for drought with 1000 and 1473 In England rain fell only six times between February and Sept 19, and in Zurich only four times during the same period In Regensburg and Milan there was practically no rain for five months In Switzerland it was known for a century as 'the hot summer' The following year, 1541, was also very dry in England, and the combined effect of these two years had serious consequences Almost all the small rivers dried up, the River Trent diminished to a straggling brook, and the Thames fell so low that even at ebb tide sea water extended beyond London Bridge—an unheard of phenomenon at that time Many cattle died for want of water, especially in Nottinghamshire, and many thousands of persons died from grievous diarrhœa and dysentery

Societies and Academies

LONDON

Royal Society, Feb 13—**G Slater** Studies on the Rhone Glacier, 1927 The structure of the ice in a compressed zone on the south eastern part of the glacier This zone is marked by a series of ridges dissected by three crevassed longitudinal basins The structure of the easterly ridge, which was plotted to scale, showed a complete disarrangement of the normal ribbon structure, the ice being dissected into blocks by thrust planes The general strike of the thrust planes suggests a deviation of the ice southwards from the normal south westerly movement of the glacier Relief from pressure was obtained by upward movement along thrust planes, and by lateral squeezing towards the tensional areas The structure developed in the glacier is the same in principle as that of the disturbed Pleistocene drift deposits of Europe and America —**T Goodey** On a remarkable new nematode *Tylenchinema oscinellæ* gen et sp n, parasitic in the frit fly, *Oscinella frit* L, attacking oats The parasite is widely distributed in England and Wales, its life history and the development of the gonad for both sexes are described The general result for the host is sterilisation —**D E Sladden** Distortion of development in amphibia caused by lack of oxygen in very early stages in development Eggs of the common frog deprived of oxygen, either by sugar solution or by reduced air pressure, gave rise to tadpoles showing various types of abnormalities The abnormalities present at the time of hatching died shortly after, leaving only apparently normal larvæ. From among these, however, after a period of about eight weeks, abnormalities showing flexure in tail, distortion of sacral region, and in one case suppression of hind limb, made their appearance These latter were successfully reared through metamorphoses —**Sir Frederick Keeble, M G Nelson, and R Snow**—The integration of plant behaviour (Pt 2) The influence of the shoot on the growth of roots in seedlings By removing the shoot in young pea seedlings or the shoot and coleoptile in young maize seedlings, the growth of the main root is slightly increased for a few days, but the growth of secondary or adventitious roots is very greatly decreased By removal of the coleoptile alone in young maize seedlings, the growth of adventitious roots is decreased, but to a much less extent —**A W Greenwood and J S S Blyth** The results of testicular transplantation in brown Leghorn hens Persistent grafts of testicular substance have been obtained in a series of normal hens Modification in the functions of the ovary have been produced, both in regard to the production of eggs and to the development of the secondary sex characters

Geological Society, Jan 22—**J W Gregory, Ethel Dobbie Currie, J Weir, S Williams, and G W Tyrrell** On the geological collection from the South Central Sahara made by Mr Francis Rodd The Aïr Massif in the South Central Sahara was shown by the work of Barth (1857) and Chudeau (1907, etc) to consist of a foundation of gneiss, schist, and granite, on which rest in the north and west sheets of Devonian marine beds,

and in the south Cretaceous limestones and subaerial sandstones The gneiss and schists are probably pre Palæozoic At In Nuguren, west of the Aïr massif, there are well-preserved Turonian fossils affording evidence of a connexion of the sea in Angola with that of the Mediterranean across the Central Sahara Some terrestrial deposits earlier than the Turonian limestones contain silicified fossil wood identified as *Dadoxylon* The igneous rocks collected represent a northern extension of the Kainozoic volcanic series of Kenya and Kordofan The Cretaceous limestones indicate that the Central Sahara was partly submerged by a Turonian transgression, which connected the Angola Gulf and the Lower Niger with Tunisia It had a branch westward through In Nuguren towards the Middle Niger, but had no known connexion across Abyssinia with Somaliland or the Gulf of Aden —**J V Harrison** The geology of some salt plugs in Laristan (Southern Persia) The area is contained in the rectangle between lat 27° and lat 28° 20′ N, and long 54° 20′ and long 57° E Much of the district is covered by normally folded rocks which range in age from Ordovician to Recent, and reach an aggregate thickness of 25,000 feet The only general angular unconformity occurs high in the Mio Pliocene On the north and east the frontal part of the nappes overrides and ploughs into the normally folded rocks South and west of the line of nappes the normal folds have been invaded by plugs of salt, which have brought up quantities of gypsum and blocks of sedimentary and igneous rocks The extrusive salt has come to the surface at different times, from Oligocene to late Mio Pliocene The intrusive salt masses, sheathed with autochthonous sediments tilted around them, form, in some cases, brightly coloured mountains of very striking and characteristic appearance The formation of the salt plugs is attributed to tangential forces acting on Cambrian salt, which, on account of its comparative plasticity, has acted as something analogous to an igneous magma in its behaviour

Paris

Academy of Sciences, Jan 13 —The president announced the death of Auguste Rateau —**Ch Fabry and E Dubreuil** A supposed transformation of lead by the effect of solar radiations Criticism and correction of some results recently published by Mlle S Maracineanu No trace of either gold or mercury could be found in the specimens of lead examined —**Ch Achard and M Enachesco** The reciprocal action of chlorination and alkalinisation of the organism in acute diseases —**Maurice de Broglie** The use of gratings at grazing incidence for spectrophotography of the extreme ultra violet J Thibaud was the first to apply the use of a grating at grazing incidence to the study of the radiations in the ultra violet An account is given of subsequent developments of the method, with special reference to the X rays —**Pierre Weiss** The diamagnetism of the ions —**S Lefschetz** Continued transformations of closed ensembles and their fixed points —**Marcel Brelot** The exterior problem of Dirichlet for the equation $\Delta u = c(x, y)u(x, y)(c>0)$ —**A Métral** An essential character of conformal representations utilisable for planning the profiles of the wings of aeroplanes —**Carl Störmer** The absence of retarded (wireless) echoes during totality of the eclipse of May 9 in Indo China —**L Gaurier** The alteration of the alluvium of lakes converted into reservoirs —**L Pirot** The deviation from the vertical round the peninsula of Brittany —**Guichard, Clausmann, and Billon** The variations of the hardness of certain metals and alloys as a function of cold hardening —**Carl Benedicks** The density of some iron alloys in the liquid state —**Edlén and Ericson** The condensed spark spectrum in the extreme ultra violet to 88 A —**Georges Fournier** An arithmetical relation between the atomic weight and the atomic number —**P Mondain-Monval and Pierre Galet** The anomalies of the physical properties of the vitreous state The case of amorphous sulphur and selenium The viscosity measurements of sulphur, which were made by a form of penetrometer, showed a sharp change in viscosity at - 21° C a study of the density changes showed a point of transformation at - 20° C Similar measurements with selenium gave a clear point of inflection on the viscosity curve at 45° C and on the density curve at 31° 33° C As in the case of glass, at a temperature slightly below the softening point, sulphur and selenium undergo an allotropic transformation this takes place with a diminution of viscosity, an increase in the coefficient of expansion, and a sensible heat absorption —**Pierre Brun** The boiling points of aqueous alcoholic liquid mixtures Experiments on ternary mixtures of water, ethyl alcohol, and isoamyl alcohol have been made and the results given in a triangular diagram —**Maurice François** The action of concentrated ammonia on the compound $HgBr_2 2NH_3$ The formation of HgH_2NBr and Hg_2NBr —**Marcel Guillot** An attempt to prove the existence of a non electrolytic complex of polonium The experiments described point to the probable existence of a complex substance of the formula $Po(-S-CS-NR_2)_2$ —**Daniel Schnéegans** The presence of radiolarites in the Briançonnais sheet —**Pierre Dangeard** The influence of oxygen in iodo volatilisation Experimental proof that gaseous oxygen is necessary for the emission of iodine by *Laminaria* It is suggested that the negative results obtained by H Kylin were due to the non recognition of this fact —**Raymond-Hamet** The action of ouabaine on the intestine *in situ* The intestine when isolated is contracted by ouabaine, but the intestine *in situ* is relaxed by the alkaloid —**J Enselme** Contribution to the study of the acid hydrolysis of the proteids —**Mme Phisalix** Natural immunity against snake poison and the virus of rabies of the common dormouse, *Eliomys nitela* This animal shows no sign of poisoning after being bitten by the viper In battles between the dormouse and the viper, the former always takes the offensive and the snake is invariably killed The dormouse is also immune to intra muscular injections of the rabies virus The serum of the dormouse *in vitro* neutralised the rabic virus The immunity of this animal towards both snake poison and the virus of rabies is due to the existence in the blood of anti substances

Geneva

Society of Physics and Natural History, Dec 19 —**F Chodat** A new demonstration of the Traube cell The author proves the penetration of water into the semi permeable copper ferrocyanide membrane cell The progressive flocculation of egg albumen incorporated in the cell allows the measurement by nephelometry of the velocity of penetration by the water —**Ed Parejas** Would the Geneva basin lend itself to a study of glacial varves? The author, from the researches which he has made in the eastern part of the Lake of Geneva, considers it probable that the Geneva basin (western part) would lend itself, by the study of the varves, to an attempt at the synchronisation of the Alpine and Scandinavian post glacial deposits —**G Tiercy** On four 'mean' curves relative to the Cepheids The author has recently terminated the study of two variable stars of the Cepheid type, he proves that the new results agree very well with those that he has previously obtained for other Cepheids

Official Publications Received

BRITISH

War Office Report on the Health of the Army for the Year 1928 Vol 64 Pp iv+144 (London H M Stationery Office.) 5s net

Report on a Visit to Kenya and Uganda to advise on Antimalarial Measures By Dr S P James Pp 48 (London The Crown Agents for the Colonies) 1s

Royal Society of Arts John Street Adelphi London W C 2 Report on the Competition of Industrial Designs, 1929 Pp 51 (London)

Journal of the Indian Institute of Science. Vol 12A Part 15 The Electrical Conductivity of Thin Oil Films Part 1 General Nature of the Phenomenon By H E Watson and A S Menon Pp 207 224 1 rupee Vol 12A, Part 16 The Photo Voltaic Properties of Phototropic Mercury Compounds By Bh S V Raghava Rao Pp 225 232 8 annas (Bangalore)

Proceedings of the Royal Society of Victoria Vol 42 (New Series) Part 1, October 31st 1929 Pp v+70 (Melbourne)

The Institute of Metals List of Members, including Membership Application Form and Topographical Index to Members (Corrected to December 31, 1929) Pp 107 (London) 2s 6d

Commonwealth of Australia Council for Scientific and Industrial Research Pamphlet No 14 The Work of the Division of Economic Botany for the Year 1928 29 By Dr B T Dickson Pp 29 Pamphlet No 15 The Work of the Division of Economic Entomology for the Year 1928-29 By Dr R J Tillyard Pp 19 Pamphlet No 16 The Work of the Division of Animal Nutrition for the Year 1928 29 By Prof T Brailsford Robertson Pp 30 (Melbourne H J Green)

Commonwealth Prickly Pear Board The Progress of Biological Control of Prickly Pear in Australia. By Alan P Dodd Pp 44 (Brisbane Anthony James Cumming)

FOREIGN

Transactions of the San Diego Society of Natural History Vol 5 No 20 Fossil Diatoms dredged from Bering Sea By G Dallas Hanna Pp 287 296+plate 34 (San Diego Calif)

Memoirs of the College of Science, Kyoto Imperial University Series A Vol 12 No 6, November 1929 Pp 275 379 (Tokyo and Kyoto Maruzen Co , Ltd) 3 50 yen

University of California Publications Bulletin of the Department of Geological Sciences Vol 19 No 1 The Passerine Remains from Rancho La Brea in the Paleontological Collections of the University of California By Alden H Miller Pp 22+1 plate (Berkeley Calif University of California Press) 25 cents

Report of the Aeronautical Research Institute Tokyo Imperial University No 53 Further Researches on Periodic Columnar Vortices produced by Convection By Torahiko Terada and Mituo Tamano Pp 447 470+plates 17 31 (Tokyo Koseikai Publishing House) 0 70 yen

United States Department of the Interior Annual Report of the Commissioner of Education for the Year ended June 30 1929 Pp iii+50 (Washington, D C Government Printing Office) 10 cents

United States Department of Agriculture Technical Bulletin No 145 Life History and Habits of Grasshopper Mice, Genus Onychomys. By Vernon Bailey and Charles C Sperry Pp 20 10 cents Circular No 96 Game Birds suitable for Naturalizing in the United States By W L McAtee Pp 24 10 cents (Washington D C Government Printing Office)

Société Française de Physique Annuaire 1929, Decrets et Statuts Pp 105 (Paris)

Det Kongelige Departement for Handel Sjøfart, Industri Håndverk og Fiskeri Norges Svalbard og Ishavs Undersøkelser Skrifter om Svalbard og Ishavet Nr 1 The Norwegian Svalbard Expeditions 1906–1926 By Adolf Hoel Pp 104+8 plates 10 00 kr Nr 19 Das Festungsprofil auf Spitzbergen Jura und Kreide, 2 Die Stratigraphie Von Hans Frebold Pp 40+1 Tafel 3 00 kr Nr 20 Oberer Lias und unteres Callovien in Spitzbergen Von Hans Frebold Pp 24+2 Tafeln 2 50 kr Nr 21 Ammoniten aus dem Valanginien von Spitzbergen Von Hans Frebold Pp 21+8 Tafeln 4 00 kr Nr 22 Die Downtonischen und Devonischen Vertebraten von Spitzbergen 2 Acanthaspida Von Anatol Heintz Pp 81+24 Tafeln 15 00 kr Nr 23 Die Downtonischen und Devonischen Vertebraten von Spitzbergen 3 Acanthaspida, Nachtrag Von Anatol Heintz Pp 20+3 Tafeln 3.00 kr Nr 24 Eine Cenoma aus dem Karbon des de Geer Berges im Eisfjordgebiet auf Spitzbergen. Von Franz Heritsch Pp 21+7 Tafeln 3 50 kr Nr 25 Untersuchungen über die Ernährung der Bewohner von Barentsburg, Svalbard Von Otto Ahs Pp 64+1 Tafel 5 00 kr Norges Svalbard og Ishavs Undersøkelser Meddelelse Nr 7 Jan Mayen, en Oversikt over dens Natur, Historie og Betydning Pp 411 444 (Oslo Jacob Dybwad)

Ochrona Przyrody Organ Państwowej Rady Ochrony Przyrody Rocznik 9 Pp iii+172 (Kraków)

Państwowa Rady Ochrony Przyrody Nr 25 Sprawozdanie z Działalności, Państwowej Rady Ochrony Przyrody w Roku 1929 Napisał Prof Dr Władysław Szafer Pp 18. (Kraków)

United States Department of Agriculture Technical Bulletin No. 134 Red squill Powders as Raticides. By J C Munch James Silver and E E Horn Pp 36+1 plate 10 cents Technical Bulletin No 135 The Corn Borer in Central Europe a Review of Investigations from 1924 to 1927 By K. W Babcock and A. M Vance Pp 55+10 plates. 20 cents. Technical Bulletin No 157 The Western Grass stem Sawfly, a Pest of Small Grains By C N Ainslie. Pp 24 5 cents (Washington, D C Government Printing Office)

Poradnik dla Samouków, Tom 8 Botanika 3 Dział informacyjny, Spis czasopism, Uzupełnienia do Botaniki 1 1 2 (T 6 1 7 Poradnika), Skorowidz nazwiskowy i rzeczowy do Botaniki 1, 2 i 3. Pp. 440. (Warszawa Kasy Imienia Mianowskiego) 12 złotys

Department of the Interior Bureau of Education Bulletin, 1929, No 24 Record of Current Educational Publications, comprising Publications received by the Bureau of Education January December 1928, with Index. Pp. 128 15 cents. Bulletin, 1929 No. 30 The General Shop. By Maris M Proffitt. Pp iii+27 5 cents (Washington, D C Government Printing Office)

Anhang zu den Jahrbuchern der Zentralanstalt fur Meteorologie und Geodynamik Jahrgang 1927 Publikation Nr 135 Meteorologische Feldversuche über Frostabwehrmittel Von Wilhelm Schmidt Pp 48+2 Tafeln (Wien Gerold und Komp)

Verhandlungen und wissenschaftliche Abhandlungen des 23 Deutschen Geographentages zu Magdeburg, 21 bis 23 Mai 1929 Herausgegeben von Dr Georg Wüst Pp. 301+12 Tafeln (Breslau Ferdinand Hirt) 15 gold marks

CATALOGUES

Photography Simplified Exposure. Pp 12 (London Burroughs Wellcome and Co)

Zeiss Ikon Cameras for Press Work Pp 6 (London Garner and Peeling Ltd)

Diary of Societies

FRIDAY FEBRUARY 21

TEXTILE INSTITUTE (Lancashire Section) (at Textile Institute Manchester) at 1 15 —J Smeaton Textile Specifications and their Preparation

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botany Lecture Room, Imperial College of Science and Technology), at 2 30 —Dr W R Thompson Biological Control of Injurious Insects and Weeds

GEOLOGICAL SOCIETY OF LONDON (Annual General Meeting) at 3 — Presidential Address

DIESEL ENGINE USERS ASSOCIATION (at Caxton Hall) at 3 30 —Report of the Committee on Heavy Oil Engine Working Costs 1928–29

LONDON SOCIETY (at Royal Society of Arts), at 5 —Sir Frank Dyson The Royal Observatory Greenwich

MEDICAL OFFICERS OF SCHOOLS ASSOCIATION (Annual General Meeting) (at 11 Chandos Street W 1) at —Dr G E Friend Some Notes on the Value of Clinical Dietetic, and Physical Records in Public Schools (Presidential Address)

ROYAL SOCIETY OF MEDICINE (Balneology Section) at 5 —Dr J B Burt and others Discussion on Bath Reaction in Spa Treatment

BRITISH INSTITUTE OF RADIOLOGY (Medical Meeting) at 5 —Radiology in Gastrointestinal Diseases

ROYAL COLLEGE OF SURGEONS OF ENGLAND at 5 E R Flint The Association between Gall Bladder Lesions and Hepatitis in the Human Subject

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (jointly with Manchester Section) (at Liverpool University) at 6 —J Twomey Flour Milling

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute Newcastle upon Tyne) at 6 —Rear Admiral W Scott Hill Powdered Coal for Ship Propulsion

INSTITUTION OF MECHANICAL ENGINEERS (Annual General Meeting), at 6 — Annual Report Discussion on Sixth Report of the Steam Nozzles Research Committee

INSTITUTION OF ELECTRICAL ENGINEERS (London Students Section) at 6 15 —S H Hurt Paper insulated Power Cables

TEXTILE INSTITUTE (London Section) (at Chemical Society), at 6 45 — F T Goodall Diagnosis of Colour Faults in Finished Goods

BENSON CLUB (at Armstrong College, Newcastle upon Tyne) at 6 30 — Sir James Walker Kolbe s Electrosynthesis (Bedson Lecture)

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group— Informal Meeting), at 7 —R H Lawton Pictorial Essentials

GEOLOGISTS ASSOCIATION (North East Lancashire Group) (at Blackburn Technical College) at 7 —Miss E T Wooff A Visit to East Sutherland

JUNIOR INSTITUTION OF ENGINEERS at 7 30 —E P S Gardner The Application of Electric Welding to the Erection and Strengthening of Steel Structures

ROYAL SOCIETY OF MEDICINE (Obstetrics and Electro Therapeutics Sections) at 8 —Special Discussion on The Position of Radium in Treatment of Gynæcological Conditions Openers M Donaldson and S Dodd Obstetrics Dr A E H Pinch and Dr J F A Lynham, Electro Therapeutics

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —J B S Haldane Principles of Plant Breeding

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester) —Prof McSwiney The Problem of the Fastness of Dyes to Perspiration

SATURDAY FEBRUARY 22

GEOLOGISTS ASSOCIATION (in Natural History Museum, South Kensington), at 2 30 —Dr W D Lang Demonstration of Palaeontology and the Public

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Newcastle upon Tyne), at 2 30 —G E Tansley The Value of the Economiser in Present Day Boiler Installations —C Howson Notes on a Winding Accident at Mainsforth Colliery — Exhibition and Demonstration by E Smith of the McLuckie Gas Detector —Discussion upon Report of an Investigation of the Underground Conveying and Loading of Coal by Mechanical Means

ESSEX FIELD CLUB (at West Ham Municipal College), at 3 —Celebration of 50th Anniversary

ROYAL INSTITUTION OF GREAT BRITAIN at 3 —W Rothenstein Nineteenth Century Painting in France and England (I)

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB.—Exhibition Meeting

MONDAY, FEBRUARY 24

INSTITUTE OF ACTUARIES, at 5 —L K Elle Disability Benefits in Conjunction with Life Insurance Policies

KING S COLLEGE ENGINEERING SOCIETY (at King s College), at 5 15 —B E Willett Railway Permanent Way

INSTITUTION OF ELECTRICAL ENGINEERS (North Eastern Centre) (at Armstrong College Newcastle upon Tyne) at 7 —Informal Discussion

INSTITUTE OF CHEMISTRY (Leeds Area Section) (at Great Northern Hotel, Leeds), at 7 15 —R. L Collett and others Discussion on The Institute and the Chemical Profession

Keighley Textile Society (at Kiosk Café, Keighley), at 7 30.—H Jennison The Dyeing and Finishing of Costume Cloths.
Royal Society of Arts, at 8.—A B Searle Recent Improvements in Methods of Brickmaking (Cantor Lectures) (2).
Medical Society of London, at 8 —Col L W Harrison and others Discussion on The Treatment of Syphilis.
Royal Society of Medicine (Odontology Section), at 8 —Dr G Villain The Problem of Stabilisation and Articulation of Dentures
Royal Geographical Society (at Æolian Hall), at 8 30 —H R H the Duke of Spoleto The Italian Expedition to the Karakoram.
Cambridge Philosophical Society (in Botany School), at 8.45 —Prof E. A. Milne The Principles of Radiative and Convective Equilibrium, and their Application to the Sun and Sun spots —*Papers to be communicated by title only* —Sir J Larmor The Law of Stifling of Sound by Curtains —J B S. Haldane A Mathematical Theory of Natural and Artificial Selection. Part VI Isolation —Dr H Jeffreys The Draining of a Flat Plate —S. Verblunsky Note on the Gibbs Phenomenon.—Dr W R G Atkins and Dr H H Poole Methods for the Measurement of Daylight. —Pol Gérard Sur l'histophysiologie des annexes fœtales des mammifères —Dr Muriel Elaine Robinson Cyanogenesis in Plants —Dr J Needham The Biochemical Aspect of the Recapitulation Theory —J Henderson Smith Virus Diseases in Plants —Prof W Stiles Viscosity of Protoplasm as Determining the Rate of Biological Reactions.
Royal Aeronautical Society (at Northampton Engineering College).—C R Fairey Aviation (Walmsley Memorial Lecture)
Paper Makers Association (Technical Section Northern Division) (at Engineers Club, Manchester).—S Richardson Removable Fourdrinier and New Mechanical Drive
Royal Irish Academy (Dublin)

TUESDAY, February 25

Royal Dublin Society (at Balls Bridge, Dublin), at 4 15 —Dr W R. G Atkins Some Geo Chemical Applications of Measurements of Hydrogen Ion Concentration A W Stelfox Explorations at Kilgreany Cave Co Waterford —Prof J Reilly, P J Drumm and T Gray The Nitration of Substituted Diaryl Ethers
Royal Society of Arts (Dominions and Colonies Meeting), at 4 30 —Dr A. W Hill Scientific and Industrial Research in the British Empire
Royal Society of Medicine (Medicine Section), at 5 —Dr F G Chandler A T Edwards, Dr L S T Burrell and J E H Roberts Discussion on The Treatment of Lung Abscess
Royal Institution of Great Britain, at 5 15 —Sir William Bragg X Ray Determination of the Structure of Cellulose and Similar Substances (3).
Institution of Civil Engineers at 6 —C J R Williams The Development of Lyttelton Harbour, New Zealand —R F Hindmarsh Tyne Commission Quay North Shields —R C Bristow Cochin Harbour Works
Institution of Electrical Engineers (North Midland Centre) (at Hotel Metropole, Leeds), at 7 —L C Grant The Breaking Performance of High Power Switchgear and of a New Form of Quenched Arc Switch
Royal Photographic Society of Great Britain (Scientific and Technical Group) at 7 —Dr W Payman The Applications of Photography in Explosives Research
Institution of Engineers and Shipbuilders in Scotland (at 39 Elmbank Crescent Glasgow), at 7 30 —J W W Drysdale Marine Salvage Pumping
North East Coast Institution of Engineers and Shipbuilders (Teesside Branch—Graduate Section), at 7 30 —J Walton Some Large Span Modern Bridges and their Erection
British Psychological Society (Industrial Section) (at National Institute of Industrial Psychology) at 8 15 —Marion Milner Some American Approaches to the Study of Temperament.
Royal Anthropological Institute, at 8 30 —F W H Migeod Primitive Pictorial Art in Africa at the Present Day
West Kent Scientific Society (Annual Meeting) (at Wesleyan Hall, Blackheath), at 8 30

WEDNESDAY, February 26.

Royal Society of Medicine (Comparative Medicine Section), at 5 —Discussion on The Present Position of Distemper Inoculation
Eugenics Society (at Royal Society), at 5 15 —Dr B P Wiesner Hormones controlling Reproduction
Geological Society of London at 5 30.—S E Hollingworth The Glaciation of Western Edenside and Adjoining Areas, and the Drumlins of Edenside and the Solway Basin
Liverpool Engineering Society (at 9 The Temple, 24 Dale Street, Liverpool), at 6 30 —W Hinchcliffe Some Data relating to Modern Ships' Performance in Service
Institution of Automobile Engineers (Manchester Centre) (at Engineers Club, Manchester), at 7 —L H Pomeroy The Double Six Engine.
North East Coast Institution of Engineers and Shipbuilders (Graduate Section) (at Bolbec Hall, Newcastle upon Tyne), at 7 15 —L C Burrill Some Notes on Stability
Halifax Textile Society (at White Swan Hotel, Halifax), at 7 30 —J Hill Calculations as applied to Weaving.
Royal Society of Arts at 8 —Prof F A. E Crew Genetical Methods of Live Stock Development.
British Psychological Society (Medical Section) (at Royal Society of Medicine), at 8.30 —Dr M D Eder On the Psychology of Values.

THURSDAY, February 27

King's College Engineering Society (at King's College), at 5 15 —B C Mathieson Modern Practice in the Manufacture of Portland Cement.
Royal Institution of Great Britain, at 5 15 —J B. S. Haldane Some Problems of Genetics.
University of London Animal Welfare Society (at Royal Veterinary College), at 5.15 —B M Batten, J H Driberg, and others Public Discussion on The Problem of Trapping.

Institution of Electrical Engineers, at 6.—Capt P P Eckersley Broadcasting by Electric Waves (Faraday Lecture).
Institute of Metals (Birmingham Local Section) (at Chamber of Commerce, Birmingham), at 7 —R. W Bailey Creep of Metals at High Temperatures.
Royal Aeronautical Society (Jointly with Institution of Automobile Engineers) (at Royal Society of Arts), at 7 45 —A J Rowledge Latest Developments of Aero Engine Practice
Institution of Welding Engineers (at Caxton Hall), at 7 45 —J Ryder The Training of Operators in the Welding and Cutting Industries
Royal Aeronautical Society (Yeovil Branch) (at Yeovil).—Racing Sea planes (Lecture).
Royal Society of Medicine (Urology Section) (at Liverpool).
Oxford University Junior Scientific Club.—S Sugden Higher Valencies and the Parachor
Institute of Rubber Technologists (at Manchester Café, Ltd , Manchester) —Short Papers

FRIDAY, February 28.

Electrical Association for Women (at 46 Kensington Court) at 3 —L L Robinson Tariffs
Royal Society of Medicine (Epidemiology Section), at 5 —Sir Leonard Rogers Further Experience in Forecasting Epidemics in India and their Bearing on the Reduction of Cholera Epidemics
Physical Society (at Imperial College of Science), at 5 —C H N Lock The Equations of Motion of a Viscous Fluid in Tensor Notation —W L Watton A New Type of Dewar Flask for Use as a Calorimeter —R O Cherry Field Intensity Measurements around some Australian Broadcasting Stations
Junior Institution of Engineers (Informal Meeting) at 7 30 —J Rowcroft The Design of Dynamos for Automobiles
Royal Institution of Great Britain at 9 —Prof G I Taylor A Tour in the East Indies
Institution of Electrical Engineers (West Wales—Swansea—Sub Centre).—L C Grant The Breaking Performance of High Power Switch gear and of a New Form of Quenched Arc Switch

SATURDAY March 1

Geologists Association (at Museum of Practical Geology, Jermyn Street) at 2 30 —C P Chatwin Demonstration of The Palæontology of the Reigate Sheet
Royal Institution of Great Britain, at 3 —W Rothenstein Nineteenth Century Painting in France and England (2)
Mathematical Association (London Branch) (at Bedford College) at 3 —Prof W M Roberts Energy and some Points in St tics
Gilbert White Fellowship (at Queen Square, W C 1), at 3 —Conversazione and Exhibition

PUBLIC LECTURES

FRIDAY, February 21

King's College, at 5 30—Sir Rennell Rodd Survivals of Ancient Myth in Modern Greek Folk lore
Surveyors Institution at 5 30 —R A Watson Watt What is wrong with Wireless? (Lecture in connexion with Institution of Professional Civil Servants)

SATURDAY February 22

Horniman Museum (Forest Hill), at 3 30 —Miss I D Thornley Sanctuary in the Middle Ages

MONDAY February 24

King's College, at 4 30 —Prof E Prestage Portuguese Voyages of Discovery and Empire Building (Succeeding Lectures on Mar 3, 10, and 17)
University of Leeds at 5 15 —Dr J Chadwick Nuclear Physics

WEDNESDAY, February 26

University College at 5 30 —K G Hunt The Librarian's Problem of Catering for the Student
Belfast Museum, at 8 —C R Nodder Soap Bubbles

FRIDAY, February 28

Imperial College of Science and Technology (Department of Mathematics), at 5 30 —Prof C Størmer The Mathematical Theory of the Polar Aurora. (Succeeding Lectures on Mar 5 and 7)
University College at 5 30 —Prof E Gilson L'idée de Dieu dans la Philosophie de Descartes. (Succeeding Lecture on Mar 3)

SATURDAY March 1

Horniman Museum (Forest Hill), at 3 30 —Dr W G Ivens The Solomon Islands and their People

CONFERENCE.

February 28 and March 1

Association of Technical Institutions (at Skinners Hall, Dowgate Hill, E C 4).
Friday February 28, at 10.30 a.m —Lord Eustace Percy Presidential Address —C R. Keene The Relationship between the Teaching of Art and Technology
Friday, February 28 (*afternoon*), and *Saturday, March* 1 (*morning*) —F W Goodenough The Teaching of Salesmanship in Technical Colleges —G H Gater A Descriptive Account of Technical Education in London —E Salter Davies, Sir Percy Jackson, and Principal J H Everett The Raising of the School Leaving Age and its Effect upon Technical Education —Principal R S. Clay and others Discussion on Technical Education for the Plumbing Trade, with Special Reference to the Rural Apprentice.

SATURDAY, MARCH 1, 1930

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International Congresses

WHEN is a congress international? Still more, when is it 'truly international', as well as international in name? At first sight the question is one of nomenclature, but it covers one of principle, and of discrepant practices It has also been brought momentarily into prominence in a special case by a presidential address which, though nominally addressed to one of our 'learned societies', was in a sense encyclical [1]

Apart from œcumenical councils of—as yet—undivided Christianity, and uniformly unsuccessful attempts to 'get both sides together' in later schisms, international congresses are of recent invention, a product of an 'industrial age', with its facilities for organised study and intercommunication National conferences, such as the British Association, are meditating their centenary, few international congresses have had a jubilee, though the oldest, that were designed to be periodic, go back into the 'sixties

Even before the War, there were two grades of such congresses, one summoned by a government or governments, was composed of official delegations representing nations as such, the other was a privately arranged meeting of fellow workers in a particular branch of learning, usually convened by a leading society or institution in some one country in the name of colleagues there Naturally there were hybrids, as when a government either selected or recognised one or more of its nationals, attending a private congress, to express its goodwill, and even to concert practical measures for its own subsequent consideration

Of the status of a congress convened by invitation of one recognised government to all others, there can be no question, it is 'inter-national', a conference between representatives of nations, if there are absentees or defaulters, "the unworthiness of the minister affecteth not the efficacy of the sacrament" Also, naturally, private conferences have courted the prestige of official patronage, even when it did not bring the substantial encouragement of a subsidy

Before the War, private international congresses, however periodic by custom, were usually organised by a body of nationals of the country to which the

[1] "Anthropology National and International Presidential Address of Prof John L Myres to the Royal Anthropological Institute of Great Britain Jan 28, 1930

congress was invited, and in which it was to be more or less gratuitously entertained This had the obvious advantage that the hosts were neighbours accustomed to work together as a team, they knew local conditions, and were the persons most deeply engaged to make the meeting a success In such meetings effective international co-operation usually began only when the members assembled, and ceased after the 'butter meeting', leaving the national committee to publish 'proceedings' and pay the bills In countries where the law of associations is strict, it was necessary to incorporate a joint-stock company to hold and expend subscriptions, but its duration as well as its liability was 'limited', and in due course it went into voluntary liquidation, the doctrine of *cy-près* governing the disposal of assets, if any, either to endow research locally, or to be nest-egg for the next congress To receive such cash balance, however, some similar body had to come into existence, and accordingly some congresses established a 'permanent committee', either of nationals of the country the invitation of which for next meeting the defunct congress had accepted, or of a few eminent members irrespective of nationality In the latter event, *de minimis non curabat lex* outgoing and incoming treasurers were presumably both just and solvent, and pre War congresses were oftener insolvent than intestate

What was more difficult was to give effect to the *vœux* or resolutions of such international meetings It was all very well to refer them to a multi national committee but that way the Tower of Babel fell *quis committeret commissionem?* Again the solution, found slowly and tentatively, was in an inter-congressional executive or 'bureau'

Now, concurrently with this trend towards continuity between successive congresses, there was perceptible from about 1899 onwards, similar trend towards coherence between the leading 'learned societies' of civilised countries, towards inter-academic correlation of workers, methods, and results But an adolescent International Association of Academies, complicated by the existence of rather many academies in some countries, and of fewer, or none, in others, was suspended by the War, and the failure to resuscitate it at the Peace left both academies and congresses in chaos aggravated by a tangle

In October 1918 an 'inter-allied' conference in London called on 'allied and associated' countries to denounce all international scientific associations in which they had participated before the War It was a "drastic, and perhaps necessary act of sabotage", but it cleared the ground for the International Research Council which was established in 1919 But the International Research Council was not (at the outset) inter-national, but, at best, inter allied-and-associated This drawback was, however, remediable, in time It was a further complication that a permanent body, as the I R C was intended to be, had to have domicile some where, and the *siège social* of the I R C was, and is, in Brussels, incorporated under Belgian law The League of Nations, with domicile in Geneva, had not come into being yet

Now it was a prime function of the I R C to establish (1) national unions for collaboration in the several sciences, (2) inter national congresses between the national unions in any science, all deriving sanction and status from the I R C This was no doubt why countries adhering to the I R C were to forswear allegiance to all pre War congresses Such unions and congresses have been in due course formed and held in certain sciences, under the sanction of the I R C

What, however, governments or academies adhered to, or forswore, left many nationals—and even fellows of learned societies—unimpressed In some subjects, where the resumption of collaborated observations, in as many countries as possible, was urgent, national unions, and more or less international congresses, sprang into being forthwith In others, "time, the great reformer", has been also the great restorer of normality One series after another of the pre War congresses has been quietly revived, as soon as people felt like meeting again, and no one has been sent to the Tower for this, or excommunicated from a *siège social* anywhere

More than this, the League of Nations, through its International Committee for Intellectual Co-operation, has summoned another type of international congress—for example, at Prague in 1928 for 'popular arts', making use of a body, domiciled in Paris, and subsidised by the French Government, the International Institute for Intellectual Co-operation, the precise relations of which to the International Committee of the League at Geneva scarcely concern us here In this League type of

congress, a general assembly of members at the place of meeting elects a general committee, including many nationalities The members of this committee domiciled in Paris form a 'permanent bureau' for business between congresses, and the secretariat is supplied by the Paris Institute abovementioned Hereby the inter national character of the periodic congresses and their general assembly is assured and maintained, the local arrangements for successive congresses are made by a temporary local committee in the inviting country, as under pre War conditions while continuity in administration and collaboration in research are ensured through the liberality of the French Government and the goodwill of members resident in Paris, all under specific sanction from an international committee of the League of Nations

In anthropology, *fons et origo* of this meditation, an arrangement, superficially similar, presents, on closer examination, divergent features, which appear to have disquieted some of those concerned—not in Great Britain only Within a few days after the Armistice, an eminent institution for anthropological teaching and research, the 'École d'anthropologie' in Paris, convened a conference, attended by representatives of twelve countries, at which was founded, under the title 'Institut International d'Anthropologie', an association, domiciled in Paris, on the premises of the 'École', for "grouping, coordinating, and centralising the efforts of all persons engaged in anthropological problems, provided that they are accepted by its 'Conseil d'administration'" (or, as one of the speakers put it, "sauf l'exception que vous savez"), which, under French law regulating incorporated bodies, necessarily contains a large proportion of French nationals, and was deliberately so constituted at the first conference Actually this 'Conseil' includes twenty six Frenchmen with not more than four representatives of any other country up to a maximum of fifty Naturally, any country which desires effective representation on a body which meets in Paris most easily secures this if it is represented by Paris residents The president and treasurer of this 'Institut' must be French subjects, and the secretaries are nominated by the management of the École d'anthropologie

One, but by no means the only, function of this 'Institut' is the organisation in various countries of congresses *of its members* elected by the 'Conseil' in Paris, paying a subscription, and receiving the periodical *Révue d'anthropologie* published by the teaching staff of the Paris École, this provides the management with a means of publication for proceedings, announcements, and the like These 'adherents' in some countries have formed 'autonomous offices' rather like the 'national unions' of the I R C, except that they are solely composed of individual subscribers or affiliated societies, accepted by the 'Conseil' in Paris For each congress there is in future to be an 'international' committee, consisting of one member for each country, but its functions are advisory, not executive Countries which do not 'adhere' to the 'Institut' are nevertheless provided with a representative by the 'Conseil' Congresses of this series have been held at Liège in 1921, at Prague in 1924, and at Amsterdam in 1927, and it is reported that a similar congress is being arranged at Lisbon in 1930

At the Amsterdam congress, survivors of the pre War series of 'Congrès d'anthropologie et d'archéologie prehistoriques' (which dates back to 1867), and representatives of the Royal Anthropological Institute, discussed with colleagues of French and other nationalities the future relations between the old and the new congress organisations, and also between the Paris 'Institut' and the new series of congresses and in the following years practical fusion has been effected between the old and new series of congresses, so that it would now be possible for a congress organised on the pre War model to be convened and prepared 'par les soins de l'Institut International d'Anthropologie', without being so wholly governed by that not very international body as the present statutes prescribe

What the Paris 'Institut' may decide is a matter of immediate interest, for its adherents appear to have been informed that there is to be a congress in Lisbon in September next Presumably the moment will come when anthropologists, other than subscribing 'adherents' of the 'Institut', will have official intimation of it Governments of other nations may be invited to send delegates, as some governments did send delegates to Amsterdam But it would seem an open question whether the resolution carried by the subscribing 'adherents' there, that this congress had a "caractère vraiment international", was, or was not, rather seriously qualified by the aspiration appended to it "que ce caractère international devienne chaque fois plus effectif" If a congress be already 'vraiment international', it cannot become more so by any enhancement or recurrence, except on the Bellman's principle, "What I tell you three times is true" What all anthropologists desire—and probably many persons who are not—is that in friendly fashion this character of internationality may become not only effective but also accepted

Pioneers of Electrical Progress.

Pioneers of Electrical Communication By Rollo Appleyard Pp ix + 347 (London Macmillan and Co, Ltd, 1930) 21*s* net

THERE can be little doubt that electrical communication has done much to promote international peace It promotes a better mutual understanding between different races and prevents false rumours from spreading and warping the judgment of nations As a help to international commerce it is of the greatest value The manufacture of the necessary electrical apparatus and operating the communication lines provides work for hundreds of thousands of skilled workmen and engineers all over the world Yet it was only in June 1837 that Cooke and Wheatstone patented the first primitive electric telegraph That so little attention has been devoted to the lives of the pioneers who perfected the art is at first sight surprising But when we remember how rapidly epoch making developments have succeeded one another we see how the attention of young engineers has been attracted to the present and the future rather than to the past

In this book, brief and interesting biographies are given of the famous physicists and mathematicians who have laid well and truly the theoretical foundations on which our present systems of communication are based There are many pioneers of electrical communication who have done invaluable work, and so the author has had to choose those whose work he regards as the most fundamental Every electrical engineer and workman is continually using the names ohm, ampere, and volt, yet there are many of them who have forgotten or who never knew that they were called after the great physicists, G S Ohm, A M Ampère, and A Volta There are many more who have only the haziest notions about the personality of these great men, of their environment, and the nature of their life work Mr Appleyard has therefore rightly included them amongst the ten pioneers he has chosen

The author begins by giving an excellent biography of Clerk Maxwell He has taken pains to verify his references and to introduce the right atmosphere into his descriptions Old students will recognise the picture of the lecture room in the Cavendish Laboratory at Cambridge where Maxwell lectured, but in his time there were no modern electric light fittings and switchboards The writer remembers it well in Lord Rayleigh's and J J Thomson's time Maxwell, like Kelvin, was much interested in gyroscopes One of these (p 19) which he showed at Cambridge so far back as 1857 is of the well-known 'diabolo' pattern

Maxwell's electromagnetic theory of light and the great part this theory played in the development of radio telegraphy and telephony is well known Considering the immense amount of highly original work he did, the cutting short of his life at the comparatively early age of forty-eight, when his activities were at their greatest, was an irreparable loss to the scientific world He left to his successors his equations and his theories, which are of inestimable value in scientific work and in telegraphy and radio communication

The story of André Marie Ampère is well related In 1793 his father died on the scaffold, a victim of the 'terreur' The shock of this tragedy produced a complete nervous breakdown of the son, who was then eighteen years old The shadow lasted for more than a year, but his love for mathematics and physics was one of the main factors which effected a cure His great work on the mutual action of two currents, published in 1820, and his wonderful book on electricity and magnetism, published in 1822, led to his election to the professorship of physics in the Collège de France in 1824 He died in 1836 Maxwell well described him as the Newton of electricity, and his name has been universally adopted for the unit of current

Alessandro Volta was born in 1745 and was educated at Como His early leanings were towards literature, but when he was twenty four he was attracted by chemistry and physics He was a man of affairs and a great traveller, visiting Holland, Germany, England, and France, where he met many of the great men of science He married in 1794, and during the next five years wrote many valuable memoirs His home at Como was in the centre of the tempest raging between Austria, France, and Italy at the beginning of last century In 1801, on the invitation of Napoleon, he visited Paris and gave a demonstration before the French Institute Napoleon showered gifts and dignities upon him, making him a comte and senator of the realm of Lombardy He died at the age of eighty two

Georg Simon Ohm belonged to a German burgher family He was born in 1787 and died in 1854 He was an instructor at the Military School in Berlin, then a professor of mathematics at the University of Erlangen, and finally he was appointed in 1849 professor of physics at the University of Munich. His work on electricity was at first neglected, but

the English physicists acknowledged freely their great indebtedness to Ohm

The other biographies given by the author are those of Wheatstone, Hertz, Oersted, Heaviside, Claude Chappe, and Ronalds The book is full of attractive pictures, including portraits of the pioneers, and much of the interesting apparatus used in their researches Visits were made in many cases to the towns where the pioneers dwelt, and photographs taken of the houses in which they lived and of the monuments erected to their memory A R

Nature Unadorned in Tropical Africa

Zwischen Weissem Nil und Belgisch Kongo Von Hugo Adolf Bernatzik Mit Beitragen von Prof Dr Otto Reche, Prof Dr Bernhard Struck und Dr Hellmut Antonius Pp 139+140 Tafeln (Wien L W Seidel und Sohn, 1929) 85s

PROBABLY in no part of the world can picturesque dress and fashion without clothing be studied to better advantage than on the Upper Nile Except perhaps in the Pacific Islands, no people addicted to unabashed nudity are such slaves to fashion as the Shilluks, Dinkas, Nuers, and other Nilotic races The tall Dinka, though possessing not a stitch of clothing, is a proud and haughty individual, and woe betide the Shilluk or Nuer who omits to make room enough for him on the pathway Nothing would induce him to appear in public with a faulty garter below one knee or the wrong shaped spear, and farther south, where bead ornamentation is the order of the day, and beads current money, the traveller may find himself, as the writer has done, in serious difficulties as regards ready cash if, before entering the country, he has omitted to obtain correct information as to the precise sorts of beads to take with him He may buy a choice selection in Houndsditch or in the Birmingham 'trash' markets—green, white, red, or yellow—but when he reaches, say, Northern Kairroudo, he will find that he can do no barter and his camp market soon dwindles No one will part with chickens, goat, eggs, or flour Why? Because the traveller has none of the particular blue beads which he notices are worn by all the men, women, and children of the district His beautiful Brummagem works of art are valueless

To change a fashion is not possible, but one may sometimes initiate a new one, if not in beads, perhaps in something else. Many years ago, when buying a few barter goods for an African expedition, I discovered in an East End cheapjack's shop an opera hat labelled one shilling, and after a little loitering succeeded in purchasing a box of fifty at the price of sixpence each Taking them out to railhead on Lake Victoria, I travelled amongst a tall and naked people, making a judicious present of an opera hat to an occasional chief, snapping it open and shut to the huge delight and curiosity of the intended recipient and his retinue Before a week had gone by the fashion was set Opera hats were the vogue Chiefs and Prime Ministers were as thick as bees as soon as camp was formed Goats, chickens, and everything that could be thought of, were for sale, even ivory One big chief from afar appeared dressed in a lady's very dirty old blue dressing gown, without fastenings and split down the back—the only clothed man in the district How he could have acquired such a possession was difficult to conjecture He brought a small tusk of ivory and wanted a hat in exchange, which he was given After trying the opening and shutting trick to the intense interest of the assembled multitude, which laughed in unison with him, he placed it proudly on a head much too large for its covering It was then the giver's turn to laugh discreetly

The prevailing present day fashions amongst Nilotic tribes may be well studied by a perusal of Dr Hugo Adolf Bernatzik's recent publication Less than a third of this big volume consists of letterpress, the remainder being a series of enlarged and wonderfully reproduced photographs As explained in the foreword, it is the outcome of an expedition decided upon originally for the purpose of taking photographs and films of people and animals in those parts of tropical Africa which are at present little known and difficult to reach He was anxious, the author says, first to visit the hilly country between the Nile and Lake Rudolf, and then to travel westward to the Atlantic through the Belgian Congo, photographing native inhabitants and the animals along the margins of the "mighty Congo forests" He had no success, however, as regards visiting the regions he specially wished to explore After eighteen months' preparation, the expedition duly arrived at Khartoum in January 1927, with a very extensive outfit consisting of 2 cinema cameras each with 5 objectives, 6 cameras, with 2 telephoto lenses and a flashlight apparatus, etc A thousand plates and ten thousand metres of film were also provided, and accompanying the author was Bedrich Machulka, of Prague, as safari leader On reaching Khartoum, great was their disappointment to learn that the regions west of Lake Rudolf were out of bounds, owing to the fact of the turbulent Turkana tribes being still only

partially under administrative control, a well-known fact that should have been ascertained beforehand In the alternative, the expedition travelled by sailing Ghayassa to the limits of the navigable Nile at Redjaf, making short motor-car and porterage trips to the Nuba Mountains, Rumbeck and Meridi in the Bahr-el-Ghazal, and elsewhere

Owing mainly, it would seem, to sleeping sickness regulations and the fear of malaria—for he refers to a series of dangerous tropical diseases—Dr Bernatzik never managed to get far from the river, and did not succeed in taking any animal photographs, or apparently in making any important zoological or ethnological collections, but occupied his time, during one dry season, in the thickly populated regions inhabited by Shilluks and Dinkas, photographing things and people, chiefly scenes depicting village life—dress, occupations, dances, etc His series of 204 magnificent photographs tell their own tale far better than any description could do The letterpress of the book contains little new information regarding the fairly well known life and customs of these tall, nude, cattle tending and peaceful tribes on the Upper Nile

In this attractive picture book, no less disregard of European conventionalities is shown by the photographer, in his endeavour to portray actual conditions faithfully, than is displayed by the Shilluk and his neighbours in their absolute unconsciousness of nudity Being within the local fashion, outward contentment reigns amongst them, though inwardly these people are filled with astonishment at the grotesqueness of the white man's clothing, to them quite unnecessary

Cuthbert Christy

Explosion Researches

Gaseous Combustion at High Pressures being mainly an Account of the Researches carried out in the High Pressure Gas Research Laboratories of the Imperial College of Science and Technology, London, together with the Equipment and Experimental Methods Employed By Prof William A Bone, Dr Dudley M Newitt, and Dr Donald T A Townend Pp xiii + 396 + 14 plates (London, New York and Toronto Longmans, Green and Co , Ltd , 1929) 42*s* net

It was at one time a practice as common as it is commendable for the author or instigator of scientific work that mattered to publish a volume of 'collected researches', wherein were reprinted such of his scattered papers, first published in the journal of one or other scientific society, as the author considered most worthy Prof Bone, to judge from his recent "Flame and Combustion in Gases" and his still more recent "Gaseous Combustion at High Pressures", rightly believes this to have been a helpful practice—helpful perhaps to himself and his students, in enabling a conspectus of work accomplished readily to be made, and helpful undoubtedly to other scientific workers in the same or adjacent fields

"Gaseous Combustion at High Pressures" lacks the fascination of the earlier volume, partly because the subject dealt with is more restricted, and largely because there is so little information from other sources with which to make comparison Organised research on the combustion of gases at high pressures has hitherto been confined to Prof Bone's laboratories No one who has had the privilege of working with Prof Bone, or who has studied carefully the published accounts of his work, can have failed to be impressed by his thoroughness, his attention to detail, and his manifest determination to 'make sure of his facts' There is therefore a predisposition to take the correctness of his observations (if not his interpretation of them) for granted But the new observations are so many, and some of them so surprising, that it is disconcerting to have no check on any of them No doubt one of the objects of the present volume is to encourage others to embark on what is a peculiarly difficult (and potentially dangerous) study It is to be hoped that it will have that result

To those who, to quote the authors, "may be induced to enter the field", the most valuable chapters of the book will be the first seven These describe the apparatus installed at the High-Pressure Gas Research Laboratories at the Imperial College, London, with special emphasis on the precautions necessary to ensure safety in its use The preparation, storage, and compression of gases, the compressibilities of gases and their mixtures , the character of the explosion-vessels and of the filling system, with its valves and gauges , and the pressure gauges used for recording the development of the explosion pressures, are all described with a wealth of detail which should warn anyone who undertakes similar experiments against the pitfalls that the authors themselves have encountered

The experimental results, most of which have been published in either the *Proceedings* or the *Transactions* of the Royal Society, deal with, as one of the principal subjects, the rôle of nitrogen in explosions of carbon monoxide and air, and the

effect of replacing nitrogen by other gases The effect of varying the initial pressure, and of the addition of either hydrogen or steam, on explosions of carbon monoxide and air is also described The significance of the formation of nitric oxide during such explosions is discussed It is made clear that nitrogen is far from being an 'inert' diluent, for "it seems probable that in carbonic oxide — air explosions, nitrogen and carbonic oxide can act 'in resonance', the nitrogen intercepting and absorbing the characteristic radiation emitted by the burning carbonic oxide, thereby acquiring increased internal (vibrational) energy and under such 'excitation' becoming chemically more active than normal nitrogen molecules of the same mean kinetic energy" (p 140)

Explosion experiments are also used to study the effect of initial pressure on the limits of inflammability of gases and to obtain information as to the specific heats and degree of dissociation of gases at high temperatures

It would be idle to attempt to discuss the several controversial matters to which the authors' interpretation of their results is directed, for, as already stated, there is no basis for comparison of the results themselves If it were permissible (and it may be) to argue from the innumerable results of explosions at low pressures, it might be suggested that, since the relationship between time and pressure, given by a time pressure manometer chart, is, unfortunately, influenced by such externals as the characteristics of the pressure gauge, the shape of the explosion vessel and the position of the point of ignition, the interpretation of time-pressure records of low pressure gaseous explosions, and it may be of these high-pressure explosions also, is rendered somewhat uncertain

The book is remarkable as a record of achievement and of triumph over difficulties As such, it should make a wide appeal

R V WHEELER

Our Bookshelf

Repetitorium der allgemeinen Zoologie (Morphologie, Physiologie, Okologie, Abstammungslehre) Von Prof Dr Walter Stempell Pp vi+268 (Berlin Gebruder Borntraeger, 1929) 7 60 gold marks

"REPETITORIUM" inevitably suggests a cram book, and in his preface the author humorously describes how he was brought to write this work especially to help the young student of medicine or of agriculture who wants to 'get up' zoology for his examination in the least possible time But if the published outcome of Prof Stempell's difficult undertaking is any true index of the extent and diversity of the zoological knowledge required from the German student at this stage in his education, then indeed the English universities should look to some revision of their teaching in the elementary grades

The first section deals mainly with morphology, and in spirit it is as far removed from the old fashioned 'type teaching' still favoured by many of our schools as it is from the specialised 'zoology for medical men' in vogue elsewhere There follow admirable sections on physiology, embryology, ecology, and evolutionary theories

The author apologises for the 'mere extract' that is all he can furnish within the limits he has set himself, and he especially directs that it be used as an accompaniment to more detailed works "An extract", he says, "can never be a really well flavoured and meaty soup" But the extract he has so skilfully prepared is far from flavourless, and one must only regret that incapacity to read foreign languages with any ease must debar so many English students from tasting this really sound decoction D L M

Die Tierwelt der Nord und Ostsee Begrundet von G Grimpe und E Wagler Lieferung 14, Teil 10f *Amphipoda* Von K Stephensen Pp 188 (Leipzig Akademische Verlagsgesellschaft m b H, 1929) 15 60 gold marks

DR K STEPHENSEN'S account of the Amphipoda takes an important place in this most useful work Such a specialist in the subject of course understands how to treat it simply and yet fully, and those who use this monograph will find their work made easy for them in many ways With this large group it is impossible to figure every species, but every genus is figured, and usually a part or parts of every species These illustrations are clear and good, and one should be able to identify from them any species in the area Useful keys are supplied beginning with the sub orders and tribes, through families and genera, to species More work than usual is involved in these keys, for in some cases the males and females are so different that they have to be specially separated

The systematic part of the work occupies 148 pages out of the whole 188 The introduction, besides describing the anatomy clearly, gives a very good account of the bionomics of the Amphipoda This is specially interesting, for it touches upon such subjects as intersexes, sexual dimorphism, breeding habits, development, life histories, food and parasites A large amount of space is given to biogeography and the detailed notes on distribution are of great value All students of the group will be grateful for this work

A New School Chemistry By F Sherwood Taylor (Dent's Modern Science Series) Pp viii+508 (London and Toronto J M Dent and Sons, Ltd, 1929) 5s

ALTHOUGH the subject matter of this elementary text book is not new, the author's presentation of it is clear and attractive, the chapters being divided into descriptive text, practical exercises,

and examination questions Short summaries and experiments for demonstration are sometimes appended, and the time required for each exercise is also given This should be very helpful to the teacher in organising his practical classes In the section on chemical theory, the combination of the two equations representing the effects of pressure and temperature on the volume of a gas (p 137) may cause some difficulty, and the reason for introducing the idea of 'molecules' is not quite clear, otherwise the reasoning which leads up to the determination of atomic weights seems to have been admirably condensed

The chapter on double decomposition opens well with the statement that acids, alkalis, and salts are all polar compounds, and a hint is given that two types of union may be involved in compounds like copper sulphate and that these two types are due to the sharing of electrons and to electrical attraction respectively Nevertheless, the chapter on valency is disappointing, no attempt being made to use the terms electrovalence and covalence Electrolysis and qualitative analysis are also dealt with in an elementary way, but the ionic hypothesis is not used In the chapter on acidimetry the advantage of calculating the normalities of solutions is clearly explained

Haliotis By Doris R Crofts (Liverpool Marine Biology Committee L M B C Memoirs on Typical British Marine Plants and Animals, 29) Pp viii + 174 + 8 plates (Liverpool University Press of Liverpool, London Hodder and Stoughton, Ltd, 1929) 10*s* 6*d*

The L M B C Memoirs are indispensable 'apparatus' in all zoological laboratories, and especially is this true of the little monographs on the Mollusca All teachers know the difficulty of describing to a class the intricate peculiarities of molluscan structure, and it is not until the student sits down with scalpel and forceps to unravel for himself the intertwisted parts that he begins to appreciate their relations

Miss Crofts' volume on *Haliotis* is a valuable addition to the series, for this animal is "the only primitive British gastropod which is large enough for satisfactory dissection", and its general anatomy has never before been given completely by any one author Clear directions for dissection are set forth, and, in addition to the plates, there are many text figures that help to elucidate puzzling features in the anatomy There are some interesting new bionomical notes, and the author strongly recommends the formation of permanent reservation areas off Guernsey to make good the serious depletion of the crop of 'ormers' that two years' suspension of the fishery there has only partially stayed D L M

Practical Criticism a Study of Literary Judgment By I A Richards Pp xiii + 375 (London Kegan Paul and Co, Ltd, 1929) 12*s* 6*d* net

This book has attracted much attention in literary circles, but it deserves notice here also, because it is a good example of the present tendency to bridge the old gulf between the study of the humanities and the study of science Mr Richards points out that there are subjects which can be discussed in terms of verifiable facts and precise hypotheses These are the subjects called the sciences There are other subjects, such as the concrete affairs of organisation and administration, which can be handled by rules of thumb and accepted conventions Between these two come ethics, metaphysics, theology, æsthetics, and so forth, the sphere of "random beliefs and hopeful guesses"

Mr Richards takes one of these fields of warm disputation, that of literary criticism, and makes it the subject of as scientific an inquiry as the nature of the case permits By an interesting expedient, devised in the course of teaching duties, he got a large number of people, similar as to age and general culture, to pass unbiased judgments upon certain selected poems of unrevealed authorship The results seem to have surprised even Mr Richards, for the same poem was described in terms ranging between "this is a fine poem" and "this is absolute tripe" Here, then, is the problem Can nothing be done to improve the technique of criticism? The familiar watchwords of the great critics do not help much, because they are only pointers which may lead different minds to widely different conclusions Mr Richards ends his fascinating inquiry by a warning against the abuse of psychology, and some suggestions towards clearing away the fogs of criticism The better teaching of English is, he thinks, the chief hope

A Countryman's Day Book an Anthology of Countryside Lore Compiled and arranged by C N French Pp xxvi + 254 (London and Toronto J M Dent and Sons, Ltd, 1929) 6*s* net

This collection of weather 'saws' and countryside lore will interest and amuse many people of very varied interests Meteorologists, farmers, gardeners, and many others will find in the quotations from old anthologies and in the popular sayings a modicum of truth, but such a preponderance of error as to cause wonder regarding the origin of most of these popular beliefs of bygone times As the title indicates, a set of 'saws' and quotations is given for each day of the year The book is dedicated to cottage gardeners, and contains a number of quaint illustrations copied from ancient sources

La vie du globe et la science moderne Par Prof L Houllevigue Pp xi + 244 (Paris Armand Colin, 1929) 14 francs

In a number of short essays, the author of this little volume has succeeded in giving a general account of modern ideas bearing on the physics of the globe There is no attempt at detailed treatment, for the book is written for the general reader and not the specialist, but Prof Houllevigue has chosen his matter well and has a faculty of lucid exposition without the waste of words His book should prove of interest to workers in other branches of science who care to know the trend of thought in terrestrial physics

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

Spectrum of the Sunlit Auroral Rays

IN a letter in NATURE of Dec 21, 1929, Prof Vegard criticised some researches which Moxnes and I had published in the issue of Aug 17, 1929 In my letter I pointed out that the results obtained were only preliminary, and that the measurements of the

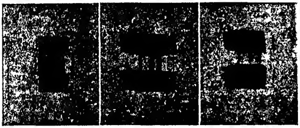

FIG 1 —Spectrum of sunlit auroral rays (*B*) as compared with spectra of ordinary aurora in the earth s shadow (*A*) and (*C*) Plates *Sonia EW*

intensities of the spectral lines were to be considered not as quantitative measurements, but only as qualitative indications of relative strength

Hoping to get more spectra of sunlit auroral rays last autumn, we made an arrangement to obtain spectra of sunlit and non sunlit auroral rays *on the*

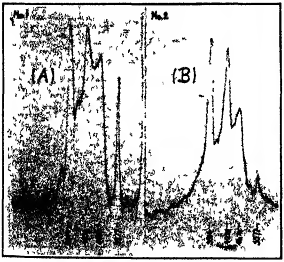

FIG 2 —Photometric registrations of the spectra (*A*) and (*B*) made by Moxnes

same plate—but no sunlit aurora rays were observed We only obtained a spectrum of an ordinary aurora in the earth's shadow, but this spectrum is very interesting as compared with the spectrum already published of the sunlit auroral rays of Mar 15–16 in so far as the aurora line 5577 A has about the same strength on both plates The nitrogen lines 3914 A and 4278 A, however, are very much stronger on the plate of Mar 15–16

As the reproduced figure of the spectra in my letter published on Aug 17, 1929, was not very convincing, I have had a better one made, where the spectra are reproduced direct from the plates This is seen in Fig 1, where *A* is the spectrum of the ordinary aurora of Mar 15–16 in the earth's shadow, *B* the spectrum of the sunlit auroral rays of the same

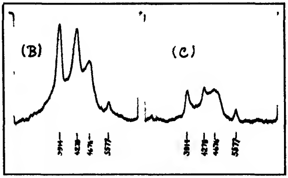

FIG 3 —Photometric registrations of the spectra (*B*) and (*C*) made by Moxnes

night, and *C* the spectrum of ordinary non-sunlit aurora from last autumn

The auroral spectra are in the middle between comparison spectra of helium and the auroral line 5577 A is to the right, the nitrogen lines to the left

In Fig 2 are shown the photometric registrations of the spectra *A* and *B* made by Moxnes already published in my letter of Aug 17, 1929 As Fig 3 we reproduce new registrams made by Moxnes of the spectra *B* and *C*, and from these our previous conclusions seem to be considerably strengthened

CARL STØRMER

Oslo

The Photo-electric Recording of Daylight

AT the Conference of Empire Meteorologists in London last August we exhibited apparatus intended for use in the photo electric recording of daylight This has now been placed in position, the photometer being on the parapet of the flat roof of the Marine Biological Laboratory at Plymouth and the recorder in the laboratory

The photometer contains a Burt vacuum sodium photo electric cell mounted in a heavy gun metal case, designed primarily for use in measuring submarine illumination There is a stout glass window, above which is a sheet of double surface flashed opal glass This acts as an efficient diffusing surface and is set horizontally so as to measure vertical illumination From the photometer case two rubber insulated high tension ignition cables, each 100 yards long, lead to the laboratory on the ground floor, being passed through cork discs—such as are used as floats for nets—to protect them from chafing They are there connected to a 60 volt ' Exide ' storage battery (five 10 v type WJ plus one 10 v type WJG) and to a Cambridge Instrument Co 'thread recorder' The accumulators maintain a steady 60 volt pressure as the photo electric current is very small, and the batteries are mounted on paraffin wax

The recorder has a scale with fifty divisions, corresponding in all to 5 micro amperes, which happens to be close to the maximum current given by this particular photometer used in mid winter noon sunlight For more intense light the current is shunted to one-half or to one fifth

The sodium cell is sensitive mainly to blue light,

but gives a good idea of the fluctuations in daylight One of the General Electric Co's new red-sensitive cells might be used instead, as it is sensitive throughout the visible spectrum, and gives a suitable current Its infra red sensitivity would, however, constitute a drawback

The smooth graph marked A on the accompanying figure shows the record obtained for Dec 19, starting from 10 A M The recorder gives one dot per minute, but where the light was changing in a regular manner dots have been omitted in the figure The sunshine recorder about 100 yards away showed 7 hr 0 min for Dec 19, the sky was cloudless with a moderate south-south east breeze The irregular graph shows the variations in light for the whole of Dec 20, which was a dry day with a south west wind of 10-15 m p h The sunshine record was zero, but the sun nearly broke through at 11 40 A M, and the vertical illumination then exceeded that of Dec 19 with clear sun The cross at noon denotes the dot obtained on Dec 19 by shading the photometer from the direct rays of the sun and is a measure of the diffuse light The ratio of total vertical to vertical diffuse light was thus found to be 1 49 At noon in midsummer this ratio, β, measured in the same position with a similar and similarly mounted sodium cell was, as a maximum, 4 28, a more usual value being about 3 3

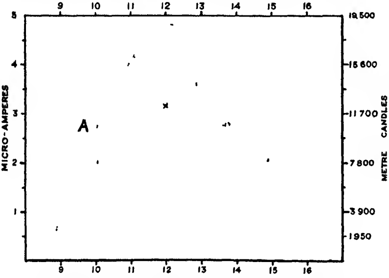

FIG 1 —The regular curve shows the vertical illumination for Dec 19 1929, starting from 10 A M, marked A The irregular curve is the record for Dec 20 For cross see text The left hand ordinates are micro amperes, the right hand are metre candles, while the abscissæ are hours The charts are marked in quarter hours and tenths of a micro ampere

The ordinates on the right hand side of the figure show metre candles, the photometer having been standardised against an open carbon arc—selected as being the source most nearly akin to daylight and easily reproducible

We hope by means of these records to be able to correlate plant growth with daily illumination in metre-candle hours The cost of the thread recorder was defrayed by the Government Grant Committee of the Royal Society

W R G ATKINS
H. H POOLE

Marine Biological Laboratory,
Plymouth, and
Royal Dublin Society,
Jan 22

The 'Wave Band' Theory of Wireless Transmission

Two obvious objections can be made to Sir Ambrose Fleming's lucid analysis of the wave band theory in NATURE of Jan 18

The first is theoretical To deny the reality of the wave band method of regarding a modulated carrier wave is at bottom much the same as to deny that a point on the rim of a rolling bicycle wheel 'hops along' in a series of cycloids In both examples the two alternative points of view have equal rights to the name 'real'

The second is practical, and so may justify this letter Two stations operating on frequencies, say, of 500 and 520 kilocycles, will not give a noticeable heterodyne note, as their beat frequency of 10,000 is too high for the average loud speaker to reproduce effectively But if one of them modulates its carrier wave by a soprano solo, bad heterodyning results every time the soprano emits a high note The fluctuating amplitude formulation does not lead us to expect this off hand, the wave band formulation does In practice, therefore, the latter is likely to hold its own

E H LINFOOT

Graduate College,
Princeton University,
New Jersey, Feb 2

SIR AMBROSE FLEMING does not give us in his very able article any alternative explanation of the fundamental problem of the tuned circuit, namely, that the really selective circuit *does* cut off the higher audio frequencies, generally explained by the 'cutting of the side bands' What is actually happening? Does not the solution lie in the fact that the damping of a resonant system falls off as its selectivity increases? In our modern lightly damped receiver, the oscillation persists long after its excitation has ceased If it is excited by a carrier modulated by a high audio frequency, the persistence of its vibrations will not allow the amplitude of these to vary with the modulated amplitude of the incoming wave and the modulation gets flattened out, whilst with a low modulating frequency, or bass note, the slower rise and fall of the carrier amplitude gives time for the circuit oscillations to rise and fall with it and thus give a faithful reproduction

So the lightly damped circuit gives a gradual falling off in intensity as we go up the scale of audio frequencies, the lighter the damping the earlier this becomes noticeable, until in the limit all audio frequencies would be 'cut off' as the 'side band' theory has it Either theory explains this, the cause of all the trouble in the ether, but, whereas the latter suggests that the defect is inherent however real selectivity is attained—that is, response only to the carrier vicinity—the former suggests that if some other means of selectivity than the lightly damped circuit could be found—even with response to the carrier alone—there is no reason why the modulation should not be faithfully reproduced The 'side band' theory puts the onus on the wave itself, the amplitude idea on the receiver, the former closes and bolts the door, while the latter leaves it open for exploration

and fresh ideas It does not then seem to be "merely a matter of a choice of points of view", as Prof Fortescue suggests

Sir Ambrose states that we do not have to alter the tuning of our condensers to receive high notes Now it is an experimental fact that if we have a receiver of several stages—say three tuned circuits, each lightly damped—the high notes will be cut down very effectively, but we can restore them by tuning one circuit to the carrier and the other two slightly above and below respectively This at first sight suggests that the side bands exist and tuning to them restores the high notes However, it admits of as good an explanation on the other theory, for it is observed that the effect of 'detuning' thus is to reduce the overall damping of the circuits—as evidenced by a reduction in intensity and a drop in the maximum amplitude—while the resonance curve becomes a steeper sided one with more flattened top Thus more selectivity is achieved without loss of damping by three detuned circuits

A A NEWBOLD

"Meadway", Cheltenham Road,
Evesham, Feb 13

ALTHOUGH the letters recently published in NATURE on the above theory have indicated that some of the contentions in my article of Jan 18 last are not generally supported by scientific opinion, yet some service has perhaps been done by it if only in eliciting the interesting letters from Sir Oliver Lodge, Sir Richard Glazebrook, Prof Fortescue, Mr Bedford, and others

In addition to noting the importance of the remarks by Sir Oliver Lodge, I find the letter of Sir Richard Glazebrook very valuable, because he gives the proof that a receiver tuned to frequencies of $n+m$ or $n-m$ can be set in oscillation by a carrier wave of frequency n modulated by an acoustic frequency m Now here we touch the very pith of the discussion When a carrier wave modulated as above is sent out from a transmitter, can we say it travels through the space to the receiver as two distinct waves of frequencies $n+m$ and $n-m$ respectively? Or is it simply a single modulated wave which can actuate a receiver tuned to the two or more frequencies?

Since we can only detect any wave by a receiver, we have the same difficulty that we have in deciding the nature of a ray of white light and how it is the prism resolves it into an infinity of rays of various wave length in the spectrum That the prism itself has a good deal to do with the effect is indicated by the phenomenon of anomalous dispersion

So it is also with the wireless receiver We have difficulty in disentangling the pure space phenomena from those produced by the receiver itself I am unable to see that those who object to my views on the wave band theory have given proof that the side waves exist in space and are not an effect due to the nature and operation of the receiver

Apart, however, from philosophical questions on which differences of opinion may exist, there is the very practical question What kind of receiver should anyone buy to obtain the best results in receiving broadcast music? An eminent scientific friend tells me in a letter that a wireless dealer told him he ought not to have a very selective receiver to get the best results Prof Fortescue seems to agree to some extent with this statement On the other hand, my experience is that the most selective receiver gives the best results, and many would agree It is, then, very important to ascertain whether good musicians with normal hearing, using highly selective receivers and listening to music of a wide range of pitch detect any enfeeblement of high notes relatively to low notes and if this effect is absent in not very selective receivers I hope some evidence on this point may be gathered in

In the present state of jam in the ether with wave lengths between 200 metres and 600 metres the wireless receiver makers require some guidance from scientific opinion as to the type of receiver they should make and advise their customers to buy The reception from 5GB, 2LO, and the Brookman's Park short wave, of broadcast music in anything like satisfactory tone is becoming very difficult and demands some remedy Is that remedy to be found in the use of hyperselective receivers or not? That is the question, and the answer to it given by experiment bears closely on the validity of the wave band theory

AMBROSE FLEMING

Manor Road, Sidmouth,
Feb 18

Crossed Connexion of the Cerebral Hemispheres with the Muscles and Sense Organs

PROF ROAF'S interesting speculation published under the above title in NATURE of Feb 8, (p 203) is based on the assumption that the two eyes possessed by most vertebrate animals have arisen in the course of evolution from a single median eye such as is found in the free swimming larva of an Ascidian He argues (if I understand him rightly) that when the image of an object falls on the left half of the retina of an animal of this type, the appropriate response is a contraction of the muscles of the right side of the creature's body and tail, and that the efferent nerve paths from the brain will therefore be simplified if the afferent fibres involved end in the right half of the central nervous system Such a view may be held to account for the central projection of the retina of each of the two eyes of a mammal in such a way that fibres from its upper half are connected with the superior lip of the calcarine fissure, and that fibres from its right margin are connected with cerebral points situated to the left of those with which areas of retina lying farther to the left are connected (This may legitimately be inferred from the work of Gordon Holmes and others on cortical projection in man) But Prof Roaf goes further and suggests that it may also account for the fact that in most vertebrates the right eye is directly connected only with the left side of the brain, and the paths from the two eyes undergo complete decussation At this point the argument seems to me to become less convincing

Even if comparative anatomists were to assure us that a single median eye was indeed the direct ancestor of our two eyes (and, so far as I am aware, such an ancestry has not previously been suggested), we should need also to be told that the evolutionary development took the form of a bisection of this eye so that the right half of its retina became the retina of the resulting right eye Alternatively we should have to assume that, in the most primitive vertebrates possessing two eyes, the left eye received images of objects lying to the right of those seen by the right eye

Now it is usual in all vertebrates, other than a few birds and higher mammals, to find the two eyes placed laterally in the head, with the right eye forming images only of objects situated on the animal's right, and with little overlap between the two visual fields Impulses from the right eye are carried to the left side of the brain, and are then relayed back to the right side in order (presumably) that contraction of muscles on this side of the animal's body may direct its movements towards the seen object If Prof Roaf accepts the rather improbable suggestions contained in the last paragraph as an explanation of the

sensory decussation, I imagine he would say that this further development of laterally placed eyes necessitated the motor decussations

Surely, however, this double decussation is an incredibly clumsy arrangement if he is right in suggesting that "By repeated correlation between stimulation due to an object and the movement to bring the image of it on the centre of the retina, a relationship [can] be established in the same way that a conditioned reflex is developed" A much simpler arrangement, and one which would avoid the double decussation, would be that found in certain cephalopods, where each eye is connected with its own side of the brain Moreover, if the fabric of the central nervous system is as plastic in the hands of evolution as Prof Roaf postulates, would it not be more probable that, early in the development of two laterally placed eyes from a single median eye, the previously crossed optic paths should become uncrossed, rather than that the whole motor system should be reshuffled and new crossed motor paths added?

Arguments like mine, based on human estimates of the unerring wisdom of providence or Nature, are notoriously fallacious, but unless some evidence is forthcoming in support of the evolutionary history outlined in my second paragraph, I find it difficult to take Prof Roaf's suggestion seriously Certainly the "crossed relationship is suggestive of an optical effect", but until more assistance is obtained from comparative anatomy the problem cannot be satisfactorily solved Ramón y Cajal's theory (1898) was also inspired by optical projection, and all that he could say in its favour in 1911 was that it "n'a pu être remplacée par un autre qui fût aussi plausible" ("Histologie du Système nerveux" Paris, II p 380) Modern knowledge of cortical projection from the retina seems to negative the fundamental assumption on which his psycho anatomical view was based Sensori-motor relations like those postulated by Prof Roaf would seem to offer a more hopeful clue (cf Sherrington, "The Integrative Action of the Nervous System", London, 1906, pp 384-386), and I hope that the question will not be allowed to drop

R S Creed

New College,
Oxford, Feb 10

Stellar Absorption Lines

Considerable attention has been recently devoted by various investigators to the explanation of the observed contours of stellar absorption lines There are many physical factors that contribute to the formation of the contour The most important are: (1) the abundance of the absorbing atoms in the gas, (2) the Stark effect, and (3) Doppler effects due to the rotation of the stars. We are here concerned with the first of these, which is usually designated as 'natural widening' of spectral lines H N Russell and others have shown that this type of broadening is particularly important in the stars because of the large number of absorbing atoms present in a stellar reversing layer. It is responsible for the enormous widths of the H and K lines of Ca^+ in the later spectral types

The 'natural widening' of spectral lines has been exhaustively studied by physicists The scattering coefficient can be expressed by

$$\sigma = c\,\frac{N\,f}{(\lambda - \lambda_0)^2},$$

where c depends upon atomic constants only, N is the number of absorbing atoms per cm^3, and f is the 'oscillator strength' According to Unsöld, the contour of a stellar absorption line is then given by

$$\frac{I}{I_0} = \frac{1}{1 + \sigma\ H},$$

where I is the intensity in the line, I_0 is the intensity of the continuous spectrum, and H is the thickness of the absorbing layer Near the centre of the line the intensity should be vanishingly small While his

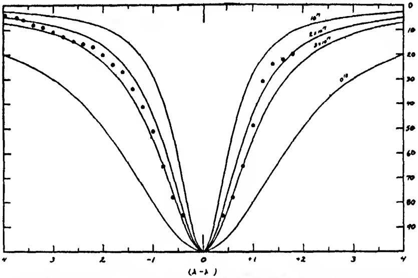

Fig 1—The contour of $H\beta$ in the spectrum of 7 ε Aurigæ the ordinates being percentages of absorption of the continuous spectrum, and the abscissæ Ångström units The dots are the mean observations from five spectrograms, and the curves are theoretical contours given by Unsöld's formula, the figures representing the values of NHf

expression for the scattering coefficient is not strictly applicable to the centre of the line itself, Unsöld has pointed out that in practice all absorption lines in which natural widening is paramount should be black in the centre That the theory is correct has been shown by R Minkowski (*Zeits für Physik*, 36, 839; 1926), who found that lines produced in the laboratory actually appear black in the centre

In the stars, on the other hand, the absorption lines do not, as a rule, appear black Even the broad calcium lines H and K show appreciable residual intensities It has been believed by many that a stellar line is never black in the centre and that the observed contour is thus in disagreement with Unsöld's theory

Our observations show that stellar absorption lines do occasionally appear black in the centre In the accompanying diagram (Fig 1) we have reproduced the contour of the $H\beta$ line in ε Aurigæ It will be seen that the observations agree very well with Unsöld's curve for $NHf = 2\ 5 \times 10^{17}$ The middle of the line is perfectly transparent on our negatives: there is no trace of residual intensity even on our longest exposures Extrapolation of the observations toward the centre would bring the residual intensity to zero, in full agreement with the theory

ϵ Aurigæ is known to be a supergiant star. Its atmospheric density must consequently be very low. This seems to support the idea, expressed first by Unsöld, that the observed residual intensities in the lines of other stars are due to some process depending upon collisions between the atoms. The fact that the hydrogen line in ϵ Aurigæ is free from the wide wings which are characteristic for other stars and are apparently produced by intra-molecular Stark effect, is itself a good indication that the pressure is very low.

O. STRUVE.
C. T. ELVEY.

Yerkes Observatory of the
University of Chicago,
Jan. 7.

Zygospore Formation in Mucors

SINCE the discovery of heterothallism, or separate sexes, in Mucors by Blakeslee some twenty-five years ago, the conception has been widely extended in the fungi and has recently been applied to the green algæ. But in recent years the facts regarding multiple sexes in fungi have become so complex as to strain credulity, and new views, such as Dame Helen Gwynne-Vaughan's conception of nutritive heterothallism, have been coming in to relieve the tension on the earlier rigid hypothesis of fixed + and − strains corresponding respectively to the female and the male sex.

Finding peculiar results from certain strains of *Mucor hiemalis* which we have had for some years in this laboratory, it was decided to make an analytical study of the process of zygospore formation in this species in relation to various media. Several other genera of Mucorineæ have also been investigated at the same time. Subcultures were made from the original stocks, and subsequent monospore cultures from these. Experiments were made, not only varying the environmental conditions such as temperature, humidity, and light, but also to show the effects of adding various substances to the agar culture medium. A few only of these experiments can be summarised here.

In the heterothallic *Mucor hiemalis*, zygospore formation is most favoured when the moisture content of the medium is at a minimum, and the humidity can be regulated by varying the percentage of agar used in making up the medium. The addition of zinc nitrate, on the contrary, appears to increase the development of mycelium and sporangia. Most of the species thrive best on an alkaline medium (pH 7·2). When + and − strains of *Mucor hiemalis* are grown together in a Petrie dish on potato agar at a temperature of about 15° C., zygospore formation appears to be completely inhibited; but identical cultures grown at 25° C. produce large numbers of zygospores. At low temperature also the two strains will not intermingle, but a line of repulsion or aversion remains between them, which appears to be due to the fact that the medium has been rendered toxic. When such cultures are placed in an incubator at higher temperature they produce zygospores.

Small doses of oxalic, formic, malic, citric, or hydrochloric acids added to the medium so as to change the pH from 7·2 to 6·8 have a toxic effect on the fungus, causing repulsion in every case; that is, with + and +, or − and −, or + and −. However, like strains grown on a medium containing starch (2 per cent), agar (1·5 per cent), and diastase (0·04 per cent) will show no signs of repulsion, but no zygospores are formed except between + and − strains. Different media produce striking effects on the morphological characters of the mycelium. Media having sugars or traces of acids produce enormous oil inclusions in the hyphæ, which are cylindrical, thick, and heavy in appearance, while on a medium without sugar or acid the hyphæ are flat, hyaline, and much less branched. In starch diastase medium the hyphæ become septate and the protoplasm highly granular.

It is found that the mycelia of + and − *Mucor*, *Rhizopus*, *Sporodinia*, and other Mucorineæ all produce two kinds of sporangia, namely, large and small, the large sporangia emitting large spores and the small sporangia small ones.

Perhaps the most striking result has been the production of imperfect zygospores from the − strain of *M. hiemalis* alone when grown on a medium composed of 1 per cent fructose, 1·2 per cent agar and a few drops of acetic acid bringing the pH to 6·8. These zygospores ceased development after fusion of the progametes had taken place, and the wall had begun to thicken. The process resembles the 'imperfect hybridisation' obtained by Blakeslee by bringing together + and − strains from different genera. In no case has zygospore formation been obtained between + strains. Chlamydospores are frequently produced in all the strains, and under certain conditions azygospores are formed.

By fixing the mycelium in 3·5 per cent formalin and staining in Ehrlich's hæmatoxylin, the nuclei in zygospore formation can be followed under an immersion lens. The pronuclei remain separate, although in close contact, so far as their history has yet been followed. Several zygospores have been germinated in hanging drop cultures by a method to be described later, and it is hoped to follow the later history of the nuclei.

This work is being extended in various directions and a full account will be published later.

R. RUGGLES GATES.
D. V. DABAN.

King's College, London,
Jan. 31.

The Viscosity of Liquids

THE viscosity of liquids is a subject which, so far as I know, has hitherto been without any general theoretical basis. No physical mechanism, for example, has ever been brought forward to account even for so simple and general a fact as the decrease of liquid viscosity with temperature, in contrast to the familiar and well explained increase of gaseous viscosity with temperature. As a result, the study has hitherto consisted largely of a collection of more or less well established empirical relations, mostly of limited scope.

In consequence of certain general theoretical considerations, shortly to be published, which I have been applying to the problem of liquid viscosity, I have not only been able to give a general account of the influence of temperature on liquid viscosity, but also I have arrived at a formula of great simplicity which fits the experimental facts very well. There is, of course, a whole collection of empirical formulæ (due to Poiseuille, Koch, Meyer, Slotte, and others—see, for example, Hatschek's "The Viscosity of Liquids" (1928)) connecting viscosity with temperature, but they have all at least three arbitrary constants, and a very limited range of validity. Different types of formula have been employed for different liquids. My formula has only two constants, so that the agreement between it and the experiment emboldens me to believe that it has some fundamental significance, as indicated by my theory. The formula is

$$\eta = Ae^{b/T}$$

where η is the viscosity, T the absolute temperature, and A and b the constants. It holds over practically

the whole temperature range with a great variety of substances The following are two examples, chosen not because of exceptional agreement, but because of the wide range of temperature and viscosity which they cover

Temp	Butyl Alcohol		Octane	
	η_{calc}	η_{obs}	η_{calc}	η_{obs}
0° C	0 0523	0 0519	0 00706	0 00706
10	0 0388	0 0387	0 00616	0 00616
20	0 0293	0 0295	0 00543	0 00542
30	0 0226	0 0227	0 00482	0 00483
40	0 0177	0 0178	0 00432	0 00433
50	0 0141	0 0141	0 00390	0 00391
60	0 01135	0 01139	0 00354	0 00355
70	0 00926	0 00929	0 00323	0 00324
80	0 00765	0 00766	0 00296	0 00297
90	0 00638	0 00638	0 00273	0 00273
100	0 00538	0 00539	0 00252	0 00252
110	0 00458	0 00460	0 00234	0 00234
120			0 00219	0 00216

η_{obs} is taken from Landolt Börnstein It is doubtful if the experimental error is less than the very slight divergence between calculation and experiment

The only general viscosity relation which I have found to provide a test for the formula is one due to A W Porter This empirical relation is as follows If two liquids be examined throughout a sufficient range of temperature, a number of temperatures T_1 can generally be found for one liquid I, at which the viscosity is the same as it is for the other liquid II at a number of temperatures T_2 If T_1/T_2 is plotted against T_1 a straight line results This relation follows at once from the formula given above For if A_1, b_1 and A_2, b_2 are the constants for liquids I and II, then

$$A_1 e^{b_1/T_1} = A_2 e^{b_2/T_2}$$

$$\log A_1/A_2 = \text{constant for the two liquids concerned} = b_2/T_2 - b_1/T_1$$

$$\text{or} \quad T_1/T_2 = \alpha + \beta T_1$$

where α and β are constants, which is the experimental relation

Water, as would be expected, and other associating liquids, demand a further constant for complete representation, but the application of the formula in the region within which it is valid, namely at high temperature, has led to interesting results, to be detailed in a forthcoming publication

E N DA C ANDRADE

University College,
London, W C 1

Botanical Nomenclature

THE letter from Mr R A Inglis in NATURE of Feb 8, p 204, calls for a reply, and the following is sent on behalf of the British Sub Committee on Nomenclature, which has since 1923 been engaged in examining proposals for the revision of the International Rules of Botanical Nomenclature Mr Inglis is mistaken in supposing that Art 57 is concerned with anything other than spelling The only Article which bears, even indirectly, on gender is Article 7, which states—albeit erroneously—that "Scientific names are in Latin for all groups" It follows that they are subject to the rules of Latin grammar, and that adjectival specific epithets necessarily agree in gender with the generic names to which they are attached The only problem is the correct gender of certain generic names The real difficulty lies in the fact that Latin as used in botany has changed *continuously* from classical times down to the present, and that the same name, for example, *Atriplex*, may have had more than one gender even in ancient Rome It seemed to the Sub Committee that an Article dealing specifically with the gender of generic names was required, and the following new Article has been submitted by them, along with other proposals, for the consideration of the International Botanical Congress (1930)

"The gender of generic names is governed by the following regulations

"I A Greek or Latin word adopted as a generic name normally retains its classical or medieval gender, even if the author who published it gave it a different gender Where, however, the classical or medieval gender varies, or is in dispute, or where it differs from the gender usually ascribed to the generic name, the gender of the latter shall be fixed by the Advisory Committee

"II Generic names which are modern compounds formed from two or more Greek or Latin words take the gender of the last If the termination is altered, however, the gender will follow it

"III Arbitrarily formed generic names, or vernacular names used as generic names, take the gender assigned to them by their authors Where the original author has failed to indicate the gender, the next subsequent author has the right of choice "

Under II, *Atrosperma* is neuter, as urged by Mr Inglis, but *Polygala*, being feminine to Pliny as well as to Linnæus, should, we think, remain feminine (under I)

T A SPRAGUE
(Convener, British Sub Committee on Nomenclature)

Royal Botanic Gardens,
Kew, Feb 14

Research and the State

I HAVE read with great interest in NATURE of Nov 23, 1929, Sir Walter Fletcher's lecture on medical research and on the inadequate rewards for such essential activities There are apparently three kinds of activities to be considered

1 The research worker who, if he is one of the best type, has the spirit of inquiry in him He is often quite indifferent to practical results Such people are not too numerous and should be given a free hand

2 The educated publicity agent who makes knowledge available The late Prof Huxley probably represented the greatest man of this type the world has seen

3 The practitioners who adapt their methods to the knowledge gained

All these groups seem to me to be equally important from the social point of view

In common with many associates I regard research conducted by permanent officials as apt to become relatively sterile Skeleton organisations and institutions for research are a necessity The ideal, however, is surely to have a fund available, and when a research worker presents a proposal really worth investigating he can be treated generously until the work is finished

Research as a profession will, I am afraid, tend to end in mediocrity and useful compilations. I am writing, however, chiefly to ask Sir Walter Fletcher how he proposes to influence the public, which, after all, find the money It is certain that the Anglo-Saxon will not act until he understands the objective It is no use presenting to him pages of mathematical formulæ and the like, interesting and useful as they are to a limited circle

In some of the American universities an official editor makes it his business to let each part of the university know what the other departments are doing, and to let all the citizens of the State obtain the

available knowledge which is furnished in clear and simple terms The University of Melbourne is con templating something of the kind at present

To me, systematic popular education is requisite if the ideals voiced by Sir Walter Fletcher are to be translated into practical action Perhaps the end can be achieved in some other way, but ultimately the public spirited citizen and the elector must be pleas antly instructed in the necessity for adequate support Lecturing him for his neglect will not advance matters

JAMES W BARRETT

105 Collins Street,
Melbourne, C 1, Jan 2

Homogeneous Catalysis of Gaseous Reactions

A SHORT time ago it was shown that the decomposi tion of di isopropyl ether in the gaseous state is sub ject to a remarkable catalytic influence of iodine The course of this reaction, which is homogeneous, and quite distinct from that of the uncatalysed re action taking place at higher temperatures, can be represented by the equation

$$\begin{matrix} CH_3 \\ CH_3 \end{matrix}\!\!>\!CH-O-CH\!<\!\!\begin{matrix} CH_3 \\ CH_3 \end{matrix} = \begin{matrix} CH_3 \\ CH_3 \end{matrix}\!\!>\!CO + CH_2\!<\!\!\begin{matrix} CH_3 \\ CH_3 \end{matrix}$$

We now find (*a*) That the same reaction takes place under the catalytic influence not only of iodine, but also of various alkyl iodides and, to a smaller extent, of bromides (*iso*PrI, EtI, MeI, *iso*PrBr, EtBr, $C_2H_4Br_2$, HBr), chlorides have little influence, (*b*) that this catalytic mechanism, involving the transfer of a hydrogen atom within the molecule, is a general one Thus the changes

$$CH_3\ \underset{\substack{|\\ H}}{CH}\ O-CH_2CH_3 = CH_3CHO + C_2H_6$$

and

$$CH_3\ CHO = CH_4 + CO$$

both occur readily in this way

The decomposition of ethyl ether is quite different from the normal homogeneous decomposition (con ditioned by the collision of two ether molecules)

It is to be noted that the hydrogen atom, the trans fer of which is catalysed, is in each case attached to the carbon atom adjacent to the oxygen

Kinetic studies of these and similar reactions are being published shortly

It is interesting to note that this phenomenon, where the hydrogen atom is loosened and transferred under the influence of an electronegative atom, is in a sense complementary to the fundamental process of acid and basic catalysis in solution, which according to Brönsted always involves the giving or accepting of a proton by the catalyst

K CLUSIUS
C N HINSHELWOOD

Physical Chemistry Laboratory,
Balliol College and Trinity College,
Oxford, Jan 29

Do Glass Tubes or Rods Bend under their own Weight?

ABOUT seven years ago, in discussion with some scientific friends, I heard the opinion expressed that glass tubes if stored upright tend to bend permanently under their own weight The same idea is to be found in print Thus, in Ostwald's "Physico-Chemical Measurements" (English Translation, 1894, p 66), we read that glass tubing "must be kept lying flat, otherwise it will become permanently curved"

It seems difficult to reconcile this with the known fact that the annealing temperature of soft glass is somewhere about 500° C , but it was thought worth while to test the point directly A glass rod 4 9 mm in diameter was laid across two nails about 1 metre apart on a brick wall, and loaded at the middle with 300 grams, which was judged to be near the limit of what it would safely bear (In fact, after the experiment was concluded, it broke under test at 1060 grams) The height of the mid point was read on a mirror glass scale , the initial loading produced a depression of 2 8 cm After that, for seven years there was no further movement large enough to be considered significant Slight changes of reading were observed from time to time, but they were not systematic, and probably due to internal movements in the wall The final reading was 1 millimetre lower than the initial one If we have regard to the last four years alone, the net change of reading has been too small to measure

The stress applied in this experiment is very great compared with any that can be caused by the weight of the rod itself It is therefore quite certain that glass of mature age does not bend in the way suspected It is perhaps just possible that newly drawn glass may do so

RAYLEIGH

Terling Place, Chelmsford,
Feb 18

"Encyclopædia Britannica"

THE version of the article 'Tides" in the 14th edition of the 'Encyclopædia Britannica", to which Prof Proudman refers in his letter published in NATURE of Feb 15, has appeared only in five per cent of the sets we expect to distribute That it appeared at all was due solely to an accident at the printers, which we much regret

The publishers have spared neither trouble nor expense to satisfy their distinguished contributor over this article , many thousands of sheets containing the first version have been destroyed, and new pages con taining the revised article printed to replace them

Moreover, in fairness to our subscribers, we think it should be added that Prof Proudman has conceded to two of our representatives that there is no error or misstatement of fact in the first version of the article, and has founded his objection to it on the ground that space was not given for a fuller elaboration of his views

The Encyclopædia Britannica Co , Ltd ,
W H FRANKS
(Manager)

Imperial House,
80 86 Regent Street,
London, W 1, Feb 17

The Classification of the Primates

IN his letter on "The Classification of the Primates" in NATURE of Jan 25, Dr Tate Regan twice refers to "the Mascarene Lemurs" The term "Mascarene" is usually restricted to the Islands of Bourbon, Mauritius, and Rodrigues, of which the first two were discovered by Mascarenhas at the beginning of the sixteenth century Is there any authority for extend ing it, as Dr Tate Regan does, to Madagascar?

The direct evolution of the Platyrrhines from a Lemuroid ancestor, independently of the Catarrhines, was suggested by W D Matthew (*Am N Y Acad Sci*, 24, pp 215 16), but he offered no valid evidence

HENRY BURY

The Gate House,
Bournemouth West, Feb 1

British Industries Fair.

THE British Industries Fair, 1930, which was held in two sections, one in London and the other in Birmingham, on Feb 17-28, has, from all accounts, been the most successful Fair of the series organised by the Department of Overseas Trade and held annually since 1915 In particular, it has had a greater success than ever before in fulfilling its primary object of attracting important overseas buyers and bringing them into touch with the British producer It is a commonplace of talk in high industrial circles that Great Britain is far behind many other countries—especially those with which it is brought into keenest competition—in the art of salesmanship The steady growth of this Fair is encouraging evidence that we are learning and mastering at least one of our lessons in this vital business art

This year the London section of the Fair was held at Olympia instead of, as formerly, at the White City, and the change has been a great gain to the appearance, compactness, and efficiency of the Fair as a business exhibition designed to do business Moreover, no visitor making a circuit of the exhibits could fail to be impressed with the variety and, in many cases—perhaps, in general—with the high quality of the goods that are being manufactured in Great Britain in these days, notwithstanding the impression created by the unemployment figures and by those journalistic jeremiads, justifiable and unjustifiable, as to the condition of British industry, that disturb the equanimity of many a British citizen's breakfast table Indeed, the psychological impression produced on the visitor by an observant tour of the exhibits is not the least of the valuable results achieved The Britisher, in particular, may well exclaim If we are doing so much so well, may we not do more even better ?

The process of what is generally termed rationalisation in industry aims comprehensively at doing better this more As was pointed out in a recent article in NATURE, rationalisation implies essentially the application of scientific knowledge, methods, and research to all the factors of industry—materials and processes, the human elements, salesmanship, and the financial and administrative organisation Just as Goethe's dying cry was for "more light", so the living cry of British industry to-day must be for "more science" If that be so, the condition of those British industries which are predominantly and essentially scientific is of vital importance to Great Britain The great chemical industry, in regard to both heavy and fine chemicals, obviously enters so largely into nearly all other industries that there is no need to stress its importance But neither the application of scientific research to the problems of industry, nor continuous scientific control, regulation, and testing of the processes and products, is possible without the aid of scientific instruments of all sorts The impression made, therefore, at the British Industries Fair by these two broad categories of scientific industries—chemicals and scientific instruments—is one that must be taken into account in any assessment of the Fair as an indicator of the scope and character of British industry In any case, the exhibits of these products are those in which readers of NATURE are most likely to be generally interested

The first point to be noticed is that in these two industries—or groups of industries—great advantage was gained by having the exhibits organised wholly or largely under the auspices of the organisations representative of the respective industries The arrangements for the Chemical Section were made under the auspices of the Association of British Chemical Manufacturers, and the exhibits in this section constituted one of the most imposing and convincing testimonies that the Fair provided of the wide range and excellence of British products It is impossible in the space at our disposal to attempt a review of the chemical exhibits, but a few of special scientific interest may be mentioned The British Drug Houses, Ltd, showed specimens of the following new products among their medical specialities acetylcholine, iodised tincture of guaiacol, and the vitamin products, radiostol, radiostoleum, and radio malt Hopkin and Williams (Travancore), Ltd, showed a collection of rare-earth minerals, including monazite sand from Travancore, which is claimed to be the richest in thorium oxide of any sand produced in quantity in the whole world The exhibits of Thorium, Ltd, included mesothorium (a by product of the thorium industry and found in monazite sand), which is largely employed medicinally and in the manufacture of self luminous compounds in place of radium The very impressive stand of the Imperial Chemical Industries, Ltd, included a small cinema where films were shown exhibiting the manufacture of explosives and of other products of constituent firms of that organisation

The exhibits of scientific and optical instruments gained enormously this year by being organised, for the most part, under the auspices of the British Optical Instrument Manufacturers' Association The large stand on which the exhibits of the constituent members of this Association were shown was one of the most striking features of the exhibition Other stalls of scientific and optical firms not within the membership of the Association were grouped near to this exhibit The total impression produced by the exhibits of scientific and optical instruments, as well as of optical glass, was most encouraging to the visitor desirous of being reassured that the products of these British industries need not fear comparison with the most renowned foreign products of like categories The developments in the highest types of binoculars were, in particular, striking On the stand of Messrs Ross, Ltd, for example, there was a stereo prism binocular of extra wide field and magnification of 7 diameters, specially designed for use at dusk and for observation at night The light transmitting

power of this instrument is remarkable, the central illumination being, it is claimed, fully 20 per cent and the illumination at margins of field 137 per cent greater than that obtained with other binoculars of the same power and aperture Messrs Barr and Stroud, Ltd, have introduced a novel element in the design of their binoculars by the use of bakelite for the usual enamelled metal parts, which has enabled the weight to be reduced We have not space to mention more of the many other excellent and novel exhibits of this section, but one general observation should be emphasised

We have already said that the scientific and optical instrument exhibits gained greatly this year by being, in great part, organised on a fairly representative single stand But while this method of exhibition has its great and obvious advantages, it can yield its greatest benefits only if it receives the whole hearted co-operation of all, or nearly all, the firms in these important industries We talk of mass action in chemical reactions, there is such a thing as mass mental effect, both as to quantity and quality, in exhibitions, and it is of great importance to realise that a visitor to the British Industries Fair, and more particularly, perhaps, a foreign visitor, cannot help getting from the exhibits of scientific and optical instruments a general net impression of what these British industries as a whole are like For this reason it is important that, at least, all the leading firms in the industry should realise the opportunities the Fair offers for creating an impression of the scope and quality of British scientific and optical instruments, quite apart from any direct benefits that may accrue to individual firms

The Function of Phosphate in Alcoholic Fermentation [1]

By Prof ARTHUR HARDEN, F R S

NATURE AND FUNCTION OF THE PHOSPHORIC ESTERS PRODUCED

If we next consider the exact nature of these phosphoric esters and the relation of their formation and hydrolysis to the decomposition of the sugar molecule, we are met with a singularly complex condition of affairs, which cannot yet be interpreted satisfactorily The main facts seem to be as follows

When fermentation of sugar by yeast preparations is carried out under suitable conditions in the presence of added inorganic phosphate, a rapid production of carbon dioxide and alcohol occurs and a phosphoric ester of a sugar accumulates, the amount of phosphate found in this form being approximately proportional in the ratio (CO_2/PO_4) to the increased production of carbon dioxide and alcohol caused by the addition of the phosphate (Kluyver and Struyk, it is true, have found lower ratios than this, but there is no doubt that high ratios, 0 8-1, are often observed)

The phosphoric ester produced, however, may consist mainly of the hexosediphosphate originally described by Young and myself or of the hexosemonophosphate described by Robison and myself and afterwards studied by Robison, or it may be a mixture of these in any proportions In the case of fermentation by dried yeast (and possibly of other preparations), a further complication is afforded by the fact that a disaccharide phosphoric ester (trehalosemonophosphate) may also be present

This conclusion is founded in the first place on a large amount of experience which has been gained at the Lister Institute in preparing hexose-mono and di-phosphate These preparations are as a rule carried out by making repeated additions of phosphate and sugar to a fermenting mixture of yeast juice or dried yeast and fructose (or glucose) With dried yeast a large proportion of the diphosphate is usually obtained, and the relatively small amount of monophosphate produced contains a considerable proportion of trehalosemonophosphate With yeast juice the results are very variable and no trehalosemonophosphate has so far been detected among the products More precise experiments have been made by Lord Henley and myself in which the gas evolved after a single addition of phosphate was carefully measured and the proportions in which mono- and di phosphates were produced were determined as accurately as possible Unfortunately, the available methods are not very good as they rest on the solubilities of the different compounds in 10 per cent alcohol, and these are to some extent mutually affected in the presence of both compounds Further, yeast, like Africa, is always yielding something new, and the recently discovered fact that pyrophosphates exist in yeast and by their formation from, or hydrolysis to, orthophosphates may cause disappearance or appearance of 'inorganic phosphate', adds another source of inaccuracy to the many previously known

Allowance has, of course, to be made for the phosphorus compounds existing in the mixture at the moment of addition of inorganic phosphate and for the normal evolution of carbon dioxide which occurs throughout the experimental period in addition to the enhanced evolution due to the esterification

In spite of these minor uncertainties, the somewhat surprising fact emerges, that whatever the nature of the phosphoric ester which accumulates, the carbon dioxide produced is approximately equivalent in the ratio CO_2 PO_4 to the amount of phosphate which undergoes esterification The full results are given in two papers published recently by Lord Henley and myself in the *Biochemical Journal*, and need not be quoted here in detail These experiments indicate the wide variation which may occur in the nature of the hexosephosphate produced, whilst the ratio of CO_2 PO_4-esterified remains

[1] Continued from p 279

constant and approximately equal to unity Two extreme cases may be quoted, in one of which 13 5 per cent of the phosphate (PO_4) esterified was present as hexosediphosphate and 86 5 per cent as monophosphate and, in the other, 97 per cent as diphosphate and only 3 per cent as monophosphate, the CO_2/PO_4-esterified ratios were 0 98 and 0 86 respectively

I do not propose to discuss in any great detail the various theories which have been proposed to explain these complicated relationships It would be natural to assume that the introduction of the phosphoric acid group into the sugar molecule forming a hexosemonophosphate might render this more accessible to decomposition into the compound (or compounds) containing three carbon atoms which are now accepted as an intermediate stage in the production of carbon dioxide and alcohol The phosphate radical from one of these groups might then serve to convert another molecule of the monophosphate into the stable diphosphate (Meyerhof)

$$2C_6H_{11}O_5PO_4H_2 = C_6H_{10}O_4(PO_4H_2)_2 + 2CO_2 + 2C_2H_6O,$$

or two of the three-carbon groups containing each one phosphate group might unite with each other forming the stable diphosphate (Kluyver and Struyk)

$$\begin{aligned}2C_6H_{11}O_5(PO_4H_2) &= 2C_3H_6O_3 + 2C_3H_5O_2(PO_4H_2)\\ &= 2CO_2 + 2C_2H_6O + C_6H_{10}O_4(PO_4H_2)_2\end{aligned}$$

Any monophosphate escaping these reactions would be found as a constituent of the mixed hexose phosphates resulting from the fermentation

To add further to the difficulty of unravelling this complex tangle, it must be remembered that, whether glucose or fructose be fermented, the hexosediphosphate produced is probably a derivative of fructose, or at least yields fructose on hydrolysis, whilst the monophosphate is with equal probability a mixture of about 80 per cent of a glucosemonophosphate and 20 per cent of a fructose monophosphate It is obvious from this that whatever changes occur are not limited to the simple introduction or removal of a phosphoric acid group, fundamental changes occur in the constitution of the molecule of the sugar itself

Attractive as is the theory of the intermediate character of any one of the hexosephosphates, it seems to me impossible at the moment to bring it into agreement with some of the facts which have just been related The production of 70 80 per cent of the monophosphate, with an unaltered degree of formation of alcohol and carbon dioxide, renders it impossible that this ester should be "obviously nothing but a part of the intermediate product which has escaped the coupled decomposition—esterification reaction" (Meyerhof and Lohmann, *Biochem Z*, **185**, 155, 1927)

It appears to me that the fundamental idea expressed in the original equation of Harden and Young is nearer the truth than any alternative that has as yet been suggested A coupled reaction of some kind occurs, as the result of which the introduction of two phosphate groups into certain sugar molecules—either into the same molecule or one each into two different ones—induces the decomposition of another molecule The introduction of these phosphate groups in the presence of muscle extract, and presumably in both muscle itself and yeast, is actually accompanied by a small evolution of heat (Meyerhof and Suranyi, *Biochem Z*, **191**, 106, 1927), and it is possible that this may have some significance for the occurrence of the coupled reaction What are the conditions for the preferential formation of the mono or di ester we do not yet certainly know, although the work of Kluyver and Struyk suggests that dilution of the enzyme may be one factor in this

The mechanism of the fermentation of the mono ester has not yet been worked out in sufficient detail to afford valid evidence either for or against the theory, but Dr Robison and I have made experiments (about to be published) which show that the monophosphate itself reacts with a further quantity of phosphate and that this reaction is accompanied by an enhanced production of carbon dioxide and alcohol

The lack of exact chemical equivalence among the products (ester on one hand, carbon dioxide and alcohol on the other) is probably more easily explicable on this view than on any other

Sugar Metabolism in Vegetable and Animal Organisms

After the establishment of the important part played by phosphates and phosphoric esters in alcoholic fermentation, it was soon found by various workers that these compounds provided the clue to many other biological phenomena The co zymase of alcoholic fermentation was found by Meyerhof to exert an equally important part in the respiration of yeast, and the important observation was made also by Meyerhof, that it occurred in muscle and was an essential factor in the carbohydrate metabolism of muscle, in which the intervention of a hexosephosphate had been proved by Embden This phenomenon was shown to take place on lines quite similar to those of the respiration and fermentation of yeast, and in 1924, before the riddle of lactic acid formation had been completely solved, Meyerhof wrote ("Chemical Dynamics of Life Phenomena") "It may indeed be considered a success of general physiology and its mode of experimenting, that the chemical dynamics of a highly differentiated organ like the muscle could be partly revealed by the study of alcoholic fermentation of yeast"

A still greater success was to follow An astonishing degree of similarity was shown to exist between almost every detail of the production of lactic acid by the muscle enzymes and of alcohol by the yeast enzymes, which extended to the identity of the phosphoric esters concerned, the accumulation of ester under similar conditions and even to the effect of arsenate on the process After the publication of Meyerhof's preliminary papers in which these observations were recorded, I wrote

(*Continued on p* 323)

Supplement to NATURE

No 3148 MARCH 1, 1930

Cellulose in the Light of the X-Rays[1]

By Sir William Bragg, K B E , F R S

ONE of the most fascinating features that emerge during the closer study of natural constructions is surely the extended use of certain atoms, certain molecules, and certain ways of combining molecules, while other atoms, molcules, and combinations are but seldom employed Thus, for example, half the world of which we have knowledge is made of oxygen silicon is used to the extent of 27 per cent, aluminum 8 per cent, iron and a few others make up most of the remainder, and some eighty or more of the 92 kinds of atoms cannot muster 2 per cent between them The seas that cover the larger part of the earth's surface give to the water molecule H_2O easy precedence over all others In the rocks, the oxygen atoms govern the structure the recent work on the silicates by W L Bragg and his collaborators shows us that we may regard the great bulk of the earth's crust as a piling together of bulky oxygen atoms cemented by atoms of other kinds such as silicon, aluminium, iron, or magnesium Sometimes the piling is of the simplest character, and seems to depend for the most part on considerations of space to be occupied Sometimes, as in quartz, more complicated structures are framed in order to satisfy the directional qualities of the mutual attractions of silicon and oxygen

If we take special note of the elements of living structure, the extraordinary predominance of the carbon atom at once attracts attention Though the mass of the carbon in the world is only about a fortieth of one per cent of the whole, its importance to life is extreme Two forms of molecular constitution are outstanding the long-chain of carbon atoms which is the basis of so many substances, fats, oils, paraffins, and so on, and the benzene ring in which six carbon atoms are tied together strongly into hexagonal form A very large proportion of organic chemistry deals with the properties of these two forms of molecules and of their derivatives , they are of the greatest importance in regard both to biochemistry and to the chemistry of industry

[1] Discourse delivered at the Royal Institution on Friday, Jan 24

Cellulose and Fibres

Cellulose is the fundamental molecular combination occurring in vegetable growth One has but to remember that forests and shrubs and grasses and plants of all kinds are mainly composed of cellulose to realise the strangeness of such a particular selection What is there in the cellulose molecule or combination of molecules that its responsibility should be so great ? It is preeminently the molecule of growth in the vegetable world It is found in the animal world also It must be a molecule by the aid of which purpose and direction can be worked out A mass of cellulose as it occurs in a plant cannot be of equal properties in all directions, for growth has to take place along definite lines With one or two stray exceptions, such as asbestos, the bulk of inorganic substances do not display that curious feature which we describe in a word as 'fibre'

Cellulose is a fibrous material, and its molecule or its molecular combination must somehow give it this fundamental character The fibrous character of the stem and leaves of plants is their most obvious characteristic the marked quality of direction is at the basis of their manner of growth and their constructional possibilities These qualities, moreover, we use for our own purposes We spin the natural fibres of cotton and hemp, ramie, jute, and the like, forming threads and ropes which have the special quality of standing strain in one direction We weave cotton goods , and we use the comminuted cellulose to make paper In these cases the fibres are distributed in one plane in more than one direction and so form sheets that stand two dimensional strain Of late years the cellulose, specially treated in various ways, is drawn out into threads of artificial silk, or rayon This fibrous quality is therefore essential not only to Nature's employment of cellulose, but also to the use that we make of it We should like to know exactly what cellulose is, and what there is in the curious structure that justifies this extensive use

Chemistry of Cellulose

The main attack upon the question has been made by the chemists, who have found it a simple matter to analyse cellulose into its constituent atoms it may be described as a multiple of $C_6H_{10}O_5$ But of course this description is quite insufficient to explain its properties there are, in fact, several other substances of the same composition, such as starch, glycogen, dextrin The distinctive properties of cellulose must depend on

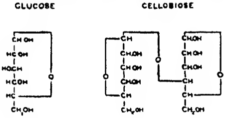

Fig 1

how these twenty one atoms are arranged with respect to one another We must therefore endeavour to discover the design It would be quite out of place to attempt a description here of the chemist's attack upon the problem of position We have already heard, at the Royal Institution, a general account of the atomic positions in the sugar molecule from Sir James Irvine, who has himself been a pioneer in this field Cellulose is closely allied to the sugars, indeed their basic features are the same A brief description of some of the chemical results will be quite sufficient for our purpose

It is certain that the six carbon atoms are connected in a chain But the chain is not to be thought of as drawn out in a straight line The chemist writes a formula of a straight line character, when he wishes merely to show which atom is attached to which, but his meaning goes no further Fig 1 shows the usual method of writing the formula for glucose, of which the $C_6H_{10}O_5$ group is the anhydrous form

Each carbon atom is attached to four other atoms the positions of the hydrogens and the OH groups, right or left of the carbons, have a meaning in that if any pair is inverted the character of the substance changes The most curious feature of the diagram is the connexion of the first and the fifth carbon atoms through an oxygen Possibly the diagram is wrong in that it should be the fourth that is joined to the first The latter view was favoured for many years, but later researches, especially by Haworth, make the 1 5 junction the more probable, and we will adopt it provisionally

Clearly, when we come to think of this set of atoms as a group in space, we must make arrangements for the oxygen at the side of the diagram to get into contact with the two atoms to which the formula attaches it Getting into contact means that the centre to centre distance between two atoms is a quantity which under similar conditions may be considered to be fairly constant It would be impossible to think of an oxygen touching the first and last of five carbons in a straight line The chain must be bent round until contact is possible, and at once we have the idea of a six atom ring, five carbons and one oxygen

There is no doubt that this ring is the basic element of all living plants and of numbers of those substances which can be derived or made from plant materials The fact stirs the imagination and the desire to investigate the remarkable structure by every means at our command A similar urge comes from the many industrial enterprises that use cellulose, from the cotton workers of every kind, from the huge concerns that make artificial silk, from the paper makers, from those concerned with celluloid, explosives, certain varnishes, and a host of other things

It has not been possible so far to go by chemical means much beyond the point already described

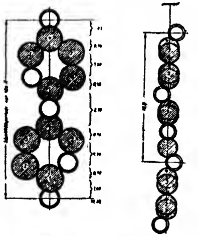

Fig 2—Model of cellobiose Shaded circles represent carbon atoms; oxygen atoms are drawn as double rings to show the limits between which their diameters probably lie This model, due to Mark, shows two glucose rings, stripped of atoms unessential for the purpose of showing the method of combination, and joined together by an oxygen to form the kernel of the cellobiose molecule Two views of the model are shown It should be compared with Fig 1

The indications become hazy, and the chemists are divided as to their meaning The most important step is the statement of the formula of the substance called cellobiose which has been derived from cellulose Cellulose, it will be remembered, is a multiple product of the element $C_6H_{10}O_5$, it is some compound made up of the rings just described,

generally known as glucose rings Cellobiose contains two rings, and the chemical evidence is in favour of combination in the manner indicated, according to chemical conventions, by the right hand formula of Fig 1 The first carbon of one glucose ring is joined to the fourth carbon of a second ring In the process, one oxygen and two hydrogens, the constituents of a water molecule, have disappeared from the combination It is further held that by tacking on a third ring with a similar oxygen linkage, cellobiose may be extended to form cellotriose, which consists of three rings, and that, finally, by the continued addition of rings, up to an indefinite number, we have the essential structure of cellulose The actual arrangement in space is probably as represented in Fig 2, but this diagram contains some information which only X rays could supply We had therefore better leave the construction at this point and consider the X ray evidence

Evidence of X ray Methods

Let us remember that the new method of X ray analysis derives its power from its capacity to detect any regularity of arrangement of atoms or molecules To such dispositions it is very sensitive it can record a perfect array of a few hundred molecules or so, or an imperfect array if the number is greater

We have seen that there must be in cellulose some directed quality, if it is to play so important a part in growth as it appears to do Of course, it may be said that direction is possibly attached as a property to some other constituent of the plant, the identity of which is yet unknown But, on one hand, cellulose is common to all plants, and their most prominent content, on the other, it turns out, as will appear, that it is easy to understand how cellulose can have the quality that we look for Now we cannot imagine how direction is to be obtained without regularity of arrangement There must be a pattern, involving the constant repetition of some form of grouping, which we might expect to be related to the line of growth We might then look at once for some such effect, when an X-ray is sent through a fibre of cotton or ramie or hemp, as we have become accustomed to find when X rays act on a photographic plate after traversing a crystal A crystal is merely a crowd of atoms in regular array

When the experiment is made, the effect is found at once Moreover, it is a kind that we recognise as indicative of fibrous nature Let us look at this point a little more closely.

When a pencil of homogeneous X rays passes through a crystal which is made to revolve about an axis, one set of crystal planes after another comes to its proper angle for reflection, and the reflected ray leaves the crystal in a direction inclined to the primary pencil at twice the reflecting angle We must remember that all the lattice points in the crystal, that is to say, points representing all the units of pattern, can be looked on in an infinite number of ways as lying on sets of parallel, equidistant planes The proper angle for reflection θ

Fig 3 —Asparagine X ray diagram obtained by W H George using the rotation method The X rays are monochromatic, and the crystal is rotated during the exposure The network at the back of this diagram is placed there for convenience of interpretation

is connected with the wave length (λ) of the rays and the spacing (d) of the planes by the law $n\lambda = 2d \sin\theta$, n being any integer

A photographic plate may be placed to receive the various reflected rays, and if both rotation axis and plate are perpendicular to the primary pencil, a symmetrical figure is formed on the plate An example is given in Fig 3 The crystal was in this case asparagine, which is a derivative of one of the constituents of wool The weight of the crystal was of the order of a milligram

From the positions of the spots and their intensities, the X-ray methods draw information respecting the crystal structure This is clearly a matter of calculation, based partly on geometry and partly on physical theories as to the reflection process We do not stop to consider the details The work of interpretation is by no means easy at all points but some results can be obtained at once and accurately, others are more difficult and less certain.

The clear separation of the spots on the asparagine photograph and their arrangement on a few well-marked lines show that the axis of rotation has coincided with an important direction in the crystal, that is to say, a line which passes through many lattice points to the unit of length, and is the intersection of a number of important sets of planes The lattice points lying on the axis are of necessity equally spaced along it, this must be so in a crystal The magnitude of this spacing is readily obtained from the photograph The spots obviously lie on a set of hyperbolæ If v_n denotes the distance of the vertex of the nth hyperbola from the horizontal line, which is called the equator, and if D is the distance from the crystal to the photographic plate, the spacing in question is equal to $(\lambda \operatorname{cosec} \theta)/n$ where $\tan \theta = v_n/D$ The proof of this rule is to be found in books on the subject Unless the spots are very hazy, this determination can be made with, at the very least, an accuracy of one or two per cent

Obviously, if a crystal were made to revolve about three different axes (not coplanar), we should in a similar way find the periodicities in three corresponding directions in space and so determine the form of the crystal lattice

X ray Diagram of Cellulose

Now if we take some cellulose fibre, such as ramie, and place it so that a fine pencil of homogeneous rays passes through it, afterwards falling on a photographic plate as in the experiment just described, we find that a spot design appears on the plate of a character exactly the same as that of the asparagine photograph It is clear, therefore, that the fibre is in some respects crystalline There is, however, one significant peculiarity in the manner of obtaining the ramie photograph It is not necessary to rotate the substance as in the case of the asparagine The explanation is that the ramie contains not one crystal but many crystals which have in common one important direction, it must be important because the photograph has clear lines Otherwise the crystals may have any disposition about this line as axis, so that the diagram is like that which a single crystal gives when it is made to rotate

Fig 4 —X ray photograph of ramie fibre

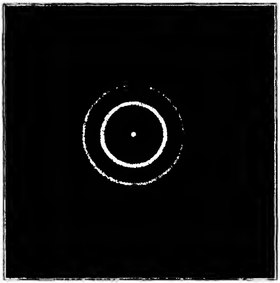

Fig 5 —Cystine This kind of diagram due to W T Astbury is typical of a substance consisting of a multitude of very small crystals not arranged with respect to each other

It will be observed that the ramie photograph (Fig 4) is not so clear as the other That is mainly due to the incompleteness of the array of the crystals with respect to each other

Suppose that the disarray were complete, as it would be if the fibrous material were so pounded or otherwise treated that the crystals pointed all ways There could then be no particular directions on the photograph, no vertical or horizontal lines of symmetry There could only be a set of rings, as if the fibre photograph were spun rapidly in its own plane about its centre An example of such a photograph is given in Fig 5, the material is cystine, one of the constituents of wool It is due to W T Astbury of the Textile Research Department at the University of Leeds

When the spots in the photograph are sharp, we conclude that the crystals are well oriented in respect to one direction, the fibre direction When there is no orientation at all, the result is as in

Fig 5 Every stage between is possible , with a small departure from orientation, the spots merely begin to spread along the circles on which they lie

Some of the blurring is due, however, to the smallness of the crystals The X ray action is of the nature of a diffraction, and it is well known that sharp images denote the combined action of many regularly arranged objects and vice versa It is even possible to estimate roughly the number of the diffracting centres in the crystal from the spreading of the spot This has been done by H Mark, whose work on the whole subject is of first importance

If now we measure the distances of the vertices of the hyperbolæ from the equator in this ramie photograph, we can, as already explained, find the length of the periodicity along the rotation axis It comes out to be 10 3 A (1 A = 10^{-8} cm)

Summing up, we now know that

(1) Cellulose contains crystals which may be invisible in the microscope but are clearly indicated by the X rays they are usually termed crystallites

(2) These crystallites are partly oriented, having one direction in common, more or less

(3) In each crystallite there is a periodicity in this special direction of 10 3 A This is often called the 'identity period'

It may not be safe to say that the whole of the cellulose is composed of crystallites, but there is a strong temptation to assume that this is so Cellulose is a multiple, as regards content, of the unit $C_6H_{10}O_5$, as we have seen reason to suppose that this unit forms a ring which is the basis of the structure The X rays do not suggest the presence of a second structure, having any real difference from the first and we suppose, therefore, that the ring structure pervades the mass When the X ray methods become more reliable in the matter of measuring the intensities of the reflection due to a given weight of the substance, in comparison with other substances of similar and known structure, we shall be able no doubt to answer this question conclusively

Comparison of the Chemical and X ray Analyses

We now return to the results of the chemical examination of cellulose and ask how our new results harmonise therewith As regards the first two deductions stated above, there can of course be no contradiction we have simply obtained some additional information on the matter of structure But the third deduction is of rather a different nature If chemistry has suggested a special arrangement of the atoms, it must show a reason for the periodicity that has been discovered Now the X rays have shown us that atoms of carbon and oxygen, when built into the regular structure of crystals, can be said to have dimensions They do not behave so simply as to warrant our thinking of them as hard spheres But when the state of combination of two atoms is known, the distance apart of their centres can be stated within limits so close as to give a determining value to estimates of structure

We know that two carbon atoms bound together in that strong fashion, which is sometimes described as due to the exercise of principle valencies, and is found in diamond, graphite, benzene, hydrocarbons, and the like, are at a distance of very nearly 1 5 A from one another, centre to centre We are not quite so sure of the value of the similar distance in the case of oxygen and carbon But from parallel cases in calcite and elsewhere we can safely assume that it is about 1 2 A In Fig 2, due to Mark, an attempt is made to apply these known distances to the determination of the dimensions of the cellobiose double ring There is naturally some uncertainty about it because the form of the ring is not yet known accurately Moreover, the way in which the oxygen bridge is fitted in, while by no means devised *ad hoc*, can only be assumed from analogy with somewhat similar cases in other crystals

The length of the double ring comes out at 10 3 A, agreeing with the X ray results Notwithstanding all its possibilites of error, such a coincidence is most striking It certainly supports excellently the idea that cellulose is essentially a long chain compound in which the glucose rings form the successive links, being attached to one another by oxygen bridges as shown in Fig 2 According to Haworth ("Sugars", p 84) the unit that is constantly repeated is formed of two rings or links, not of one, which means that the links differ from one another alternately A difference of this kind is shown in Mark's figure the oxygen bridges lie, it will be observed, alternately on one side and on the other of the principal plane of the molecule There is an imperfect repetition of the pattern at each link, and a perfect repetition at each second link It is known that such a condition should manifest itself in the X ray diagram by the weakness of the spots in the first, third, and odd numbered hyperbolæ as compared with the strength of the spots in the even numbered The effect may wear off in the hyperbolæ of high number The weakness of the first cellulose

hyperbola as compared with the second is very obvious

Thus the X-ray evidence is certainly, so far, in favour of the conception of cellulose as formed of chains of glucose rings Throughout the whole length of the chain the bonds are of the strong type such as are found in diamond The conception has been put forward before (Herzog, *Zeit ang Chem*, **34**, 385, 1921 Polanyi, *Naturwiss*, 288, 1921), though by no means accepted It is described, for example, in Haworth's "Sugars" The American botanist Sponsler, who has also used X-ray methods, has maintained it ("Colloid Symposium Monograph", 1926) In particular, H Mark has argued strongly in favour of it, and has supported his views by much experimental research Nevertheless, there are cellulose chemists to whom the idea does not appeal Trogus and Hess, for example, have argued against it quite recently

If we try to estimate the value of such evidence as this, and of much more that will presently be considered, we must recognise that it is not fully decisive On one hand, there are many factors which are not fully understood, on the other, the X ray analysis is clearly far from its full development and does not yet handle its problems with the assurance of long experience But even now the X ray evidence has a distinct value it may be expected to be worth much more in the future In this particular case, it is satisfactory to prove a periodicity which a very interesting and promising theory of cellulose would lead us to expect

The Unit of Pattern of Cellulose

The diagram has obviously more to tell us than the value of the one periodicity we have been considering The positions of the separate spots have information to give which goes far to determine the form and dimensions of the unit of pattern Suppose the unit to be represented by the rhomboidal cell in Fig 6 The implication of the 'cell' is that if we moved our point of view in the crystal from O to A or to B or to C, we should not be able to detect the change Suppose that OB is the periodicity we have found, which we distinguish by writing 10 3 alongside All the other dimensions of the cell have yet to be found

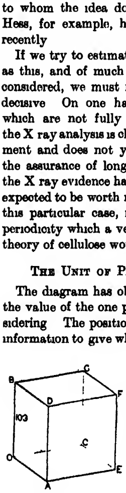

FIG 6

Every spot on the equator is made by a set of planes to which OB is parallel For example, the set of planes of which the planes $OBDA$ and $CGFE$ are consecutive members, contribute one spot to the equator row, and the position of the spot on the diagram gives us the perpendicular distance between the two faces mentioned So also for the pair $OBGC$ and $ADFE$ We may pick out two spots on the equator and decide, as we can with certain limitations which need not be discussed here, that we will make the planes to which these spots belong the faces of the unit cell But the diagram does not tell us directly what angle these faces make with each other If we had a single crystal instead of a multitude we should have no difficulty, because we should make a variety of diagrams by revolving the crystal about at least two other directions, such as OA and OC It is this lack of the single crystal that most contributes to the difficulty of our task

Nevertheless, we are not without means which will guide us indirectly if less certainly to a conclusion To begin with, the general appearance of the diagram considered in comparison with others of like origin suggests strongly that the crystal is nearly if not quite monoclinic In other words, the direction of periodicity OA and OC are nearly if not quite perpendicular to OB We may safely assume for the present that they are so For brevity's sake I do not argue this out in full If this is assumed, we have but one unknown left, namely, the angle between OA and OC To find it we have the perpendiculars from A on OC and from C on OA Also a definite assumption will carry with it the positions of all the other spots on the diagram, and though this is not so liberal in fresh information as it sounds, yet on the whole the determination of the angle is restricted to one or two very distinct possibilities

Much argument has been spent on the final choice It appears that all the details of the diagram are well satisfied if it is assumed that $OA = 8\ 35$ A, $OC = 7\ 9$ A, and the angle $COA = 84°$ nearly We have already determined OB to be 10 3 (Mark and Meyer, *Zeit Phys Chem*, **2**, 115, Andress, *Zeit Phys Chem*, **2**, 380)

An approximate knowledge of the specific gravity of cellulose is enough to show that this cell contains four of the $(C_6H_{10}O_5)$ groups

Our picture is now taking shape We picture these long chains as arranged parallel to OB (Fig 6) If the axis of one chain lies along OB, the axes of exactly similar chains lie along AD, EF, and CG Such an arrangement places the matter of two glucose rings within the six walls of the cell,

thus accounting for two out of the four rings Here calculations based on the relative intensities of various spots come to our aid, and in a manner which can be found in accounts of X rays methods, tell us that there is a chain in the middle of the cell, passing approximately through the centres of the faces *OAEC* and *BDFG* This accounts for the other two rings

The Crystallites

We must think, therefore, of the crystallite as composed of these long chains laid side by side like a bundle of sticks This prompts us to consider next the manner in which the sticks are held together

Now there is an obvious difference between the forces that bind together the links in each chain, and those that bind together the chains themselves The former are relatively very strong, all of them being of the nature of those that are found in diamond But the latter are due to the mutual action of carbon atoms the primary valencies of which are satisfied by attachments of hydrogens and of hydroxyl groups They are more of the nature of the forces that bind molecule to molecule in organic crystals like naphthalene When naphthalene melts or sublimes, its molecules are separated and these secondary valencies are snapped But the work to be done is very small in comparison with that which is required to snap the primary valencies in the molecule itself There are no hydroxyl groups in naphthalene, so that the second

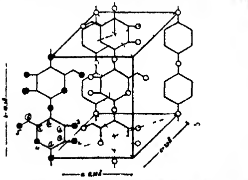

FIG 7 —Skeleton diagram showing the relative positions of the chains (From Mark and Meyer, *Zeit phys Chem*, 2, 122, 1929)

ary forces are not so large as those we may expect to find in our present case But still there must be a very great difference between the forces within the chain and those from chain to chain

We find internal evidence in the structure of our model which is entirely in sympathy with this view While the centre to centre distance of carbon atoms bound by primary valencies is nearly 1 5 A, the distance of closest approach of carbon atoms belonging to different molecules is about 3 5 A In graphite, for example, the layers are separated by a distance of 3 41 A In naphthalene, the corresponding distance is about 3 5 A, in the fatty acids it is the same If we consider the cellulose model, we see that some such distance must be assumed here also Otherwise, the chains would not come into contact with each other, they would not fill up the volume For example,

FIG 8 —X ray photographs of a paraffin, $C_{19}H_{40}$, at the ordinary temperature (*A*), and at the temperature of liquid air (*B*) (Dr A Müller) The lines in the centre are due to the various orders of reflection by the long spacing, which is actually the length of the carbon chain These are in the same positions in the two photographs But certain lines farther out are due to the sideways spacings of the chains, and these are considerably shifted by the change in temperature

the model shows the planes of the ring lying mainly in the *ab* and parallel planes, as in Fig 7, due to Mark and Meyer (*Zeit phys Chem*, 2, 122, 1929) The reflection from this set of planes is by far the strongest on the diagram, which is indeed a very important guide to the construction of the model The distance from plane to plane is 3 95 A, which fits in very well with hypothesis

Temperature Effects

A certain measure of confirmation comes from a different quarter The coefficient of expansion of diamond with temperature is exceedingly small In the case of graphite it is very small in the plane of the sheets, but many times greater at right angles thereto (Backhurst, *Proc Roy Soc*, 102, 340, 1922) In other words, the sheets do not stretch as the temperature rises, but draw apart from each other

It is to be remembered that a comparison of X-ray diagrams at different temperatures shows the expansion coefficients in every direction in a crystal This is possible even when the crystal is microscopically invisible, though the accuracy is not so great as when we have a single perfect crystal that can be handled

The observations on diamond and graphite suggest strongly that the strong carbon bonds in diamond and graphite stretch or contract very little with changes of temperature, while in the case of the weak bond in graphite there is a very

appreciable alteration in the centre to centre distance

The point is further illustrated by an effective experiment due to Dr Müller A comparison of the two photographs in Fig 8 shows that temperature affects the length of a carbon chain far less than the distance that separates the chains from one another

No doubt the changes in form which a crystal experiences when the temperature is varied are often complicated and are difficult to interpret But in these simple cases it seems clear that we are observing a difference in the reaction of primary and secondary valencies

We might certainly expect very little change in the dimensions along the cellulose chain when the temperature is lowered to that of liquid air This is exactly what Mark and Meyer have found (*Zeit phys Chem*, **2**, 127) But there is a considerable change in other directions

Mercerisation

The process known as mercerisation, so very interesting from the scientific point of view, and so important industrially, produces notable changes in the X ray diagram Yet so many of the original features remain that the new structure is obviously to be regarded as a modification of the old Most important is the fact that there is no change in the dimensions of the separate links of the chain Andress (*Zeit phys Chem* **4**, 190) has shown that the new diagram can be fully explained if the sideways relations of the chains with respect to each other are somewhat varied, in the manner depicted in Figs 9 and 10 The new arrangement is regarded as that of the stable form of the crystal, the older as the metastable

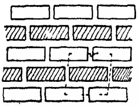

FIG 9 — General disposition of the cellulose chains, looking along the c axis

The permanence of the identity period along the chain, and therefore of the chain itself, survives not only a physical alteration such as mercerisation, but also various chemical changes For example, there are forms of trimethylcellulose, of acetyl-cellulose, and of nitrocellulose, which are crystalline, are of the same general form as cellulose itself, and have the same periodicity of 10 3 in the fibre direction In other directions there are great changes, clearly the introduction of new atomic groups between the chains must push them apart, though there may be no change in the chains lengthways When by chemical means the stranger atoms have been taken away again, the original X-ray diagram of cellulose is restored, except that in some cases, depending on the nature of the treatment, the diagram of the recovered material is that of mercerised cellulose

There are, however, other examples of cellulose derivatives which show a more radical change as the result of chemical action Another form of nitrocellulose shows, according to Mark, an identity period of 25 A, and 15 A has been found in an acetylcellulose and a cuproamine cellulose

So, in general, the chain seems to retain its nature even when subjected to wide changes of temperature and to many chemical processes All this is in entire accord with the conception of the chain of glucose rings tied together through its whole length by strong bonds resembling those of diamond a conception encouraged by the studies of the sugar chemists and now supported by the X ray evidence By sideways bonds the chains are tied together into bundles or micelles, and when the chains are long enough these sideways bonds, though individually far weaker than the others and more susceptible to physical and chemical action, will be strong enough to hold the bundle together as a definite element in the structure of the cellulose The process of the stretching and recovery from strain which fibres show in different degrees and ways, owe their many complications to the varied possibilities of gradual alterations in the alinement of the micelles, of their sliding past each other, of their partial recoveries, of their hysteresis, of their final partings when the strain is too great But these properties of fibre are fully treated in other places

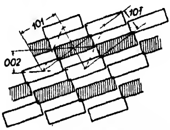

FIG 10 — General disposition of the chains in mercerised cellulose looking along the c axis

In fine, we have a striking and in some respects a very simple picture A particular form of atomic combination has been chosen by Nature to be the basis of all plant structure, and in its essential structure it already embodies the fibre principle The X ray analysis at least supports and gives some precision to views as to structure which have already been suggested There are great possibilities of improvement in the X-ray methods, and it may well be that before long their pronouncements will be much more definite

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the following passage in concluding a short review of the work (NATURE, Dec 18, 1926) "The striking similarity established by Meyerhof between the changes of carbohydrates in muscle and in the yeast cell is seen to be much closer than has been believed The remarkable phenomena accompanying alcoholic fermentation are now duplicated in the case of lactic acid production, and it may reasonably be expected that most of the fermentative decompositions of the sugars will be found to be initiated in a similar manner"

Direct proof is still wanting in many cases, but some instances are known among bacteria (Virtanen), moulds (Euler and Kullberg), and higher plants (Ivanoff, Bodnar) It is not too much to say that the fundamental biological mode of attack on carbohydrates is that revealed by the study of alcoholic fermentation

OSSIFICATION

Another biochemical function of the hexose phosphates which is shared by other hydrolysable phosphoric esters is that of a potential source of phosphate ions I am happy to say that one of the most beautiful and important developments of this idea has been worked out quite independently at the Lister Institute by Dr Robison as a direct consequence of his work on the hexosemonophosphate of yeast juice "During my investigation of the hexosemonophosphoric acid isolated from the products of fermentation", he said (*Biochem J*, 17, 286, 1923), 'the hydrolysis of the ester by enzymes was studied In some experiments in which the readily soluble calcium and barium salts were used as substrates, the progress of the hydrolysis was shown by the formation of a precipitate of sparingly soluble calcium or barium phosphate $C_6H_{11}O_5PO_4Ca + H_2O \rightarrow C_6H_{12}O_6 + CaHPO_4$

The formation of this precipitate suggested to me the query whether some such reaction might conceivably be concerned in the deposition of calcium phosphate during the formation of bone in the animal body In the first place I sought for an enzyme capable of effecting hydrolysis in the bones of growing animals"

The search was successful, a 'bone phosphatase' was found in the ossifying cartilage of young animals and a series of interesting and important investigations has followed, as a result of which I have little doubt that their author is on the highway to the biochemical explanation of the process of ossification—a good instance of the far reaching and unexpected results flowing from observations made for quite a different purpose

Obituary

PROF J M DUNCAN SCOTT

DR JAMES MATTHEWS DUNCAN SCOTT, professor of physiology in the University of Saskatchewan, died at Saskatoon on Jan 28 last Prof Duncan Scott's career as a physiologist was a relatively short one After taking an arts degree at St Andrews, and qualifying in medicine with honours at Edinburgh, he joined the forces during the War and served in Egypt At the conclusion of the War he suffered ill health for some years, owing to a troublesome frontal sinus infection which necessitated surgical intervention

After practising for a time in South Africa, Duncan Scott felt called to undertake scientific work, which had always had a strong attraction for him, and in 1921 he proceeded to Cambridge, where he held a John Lucas Walker Studentship for research in pathology His work at Cambridge was largely concerned with the regeneration of the red blood cells in anæmia Becoming interested in physiology, and particularly in the teaching of it, he obtained in 1924 a teaching post at St Bartholomew's Medical College as junior demonstrator, and afterwards became lecturer in physiology There he continued some investigations which had been commenced at Cambridge in collaboration with Dr Ffrangcon Roberts, on the situation and connexions of vagal and vasomotor centres in the medulla This work he prosecuted with great assiduity and considerable skill, as a research scholar of the British Medical Association As an outcome of his teaching work he also became interested in the physical chemistry of colloids, and held highly original, though not generally acceptable, views on that subject

In 1926, Duncan Scott was invited to the University of Saskatchewan to occupy the newly created chair of physiology This was an opportunity for the display of those fine qualities of orderliness and strict classification which had always characterised Duncan Scott Before leaving England and proceeding to found and equip a physiological laboratory under conditions of relative isolation, he prepared a list, accurately classified down to the smallest detail, of every article which would be required in such a laboratory He regarded his work there in a pioneering spirit, and as a field of high endeavour, he was, on the whole, well gratified with the results which came out of it so far as the organisation of the department was concerned The duties of organisation and teaching naturally distracted him temporarily from his research work, though he never entirely lost touch with this, and when at the annual Physiological Congress at Boston in 1929, at which he gave two demonstrations, he expressed the opinion that the first labours of organisation had now been definitely completed, and would, he hoped, leave him free to continue his research work

The passing of so courteous a colleague and of so keen a teacher and investigator will leave a gap among the physiologists of two continents Dr Duncan Scott leaves behind him a widow and three sons, to whom all his friends will extend their warmest sympathy

MR F W DOOTSON

MR FREDERICK WILLIAM DOOTSON, who died in Cambridge on Dec 12, 1929, after a very short illness, was born in Manchester on Aug 10, 1863

His long connexion with the University Chemical Laboratory at Cambridge dates from 1891, when he entered the University as an undergraduate at Fitzwilliam Hall After graduating in the Natural Sciences Tripos, he attached himself to Trinity Hall, and for many years was a successful private tutor He was also engaged in the teaching work of the Chemical Department, first as demonstrator and in later years as a University lecturer

In conjunction with the late W J Sell, Dootson published a paper on citrazinic acid, which was followed by a systematic series of investigations on the chlorine derivatives of pyridine He also published papers on derivatives of acetone di carboxylic esters, in one of which he demonstrated a very simple method for transforming an aliphatic into a benzenoid compound His last paper, published jointly with Dr S Chapman, was entitled " A Note on Thermal Diffusion "

In later years, the gradual increase in his administrative duties drew Dootson away from research During the period of the War, however, he was occupied with experimental preparative work on various substances of national importance His success as a teacher continued to the end, indeed many generations of Cambridge students will remember with gratitude his kindly and unsparing help, and his friends among the teaching staff will mourn the loss of a congenial and gifted colleague A J Berry

Dr Donald H A Hutchinson

Dr Donald H A Hutchinson, a master of the art of photomicrography, died of cancer on Feb 1, at the age of fifty-six years An ardent naturalist all his life, he concerned himself latterly with the photography of living microscopic animals by means of both still and moving pictures Many will remember the remarkable films of protozoan life which he exhibited at the Zoological Society of London in 1924 and at the British Association meeting at Oxford in 1926, but only his intimate friends will know of the amount of his work and of the patience and ingenuity with which it was achieved It was work carried out in the spare moments of a busy general practice He never sought publicity, but hoped eventually to produce an atlas of photographs of as many kinds of protozoa as possible He was always trying to get better and still better results

A few of Dr Hutchinson's photographs have recently been published in "The Science of Life", but there remain a large number of magnificent studies which have been seen by only a few The writer of this brief notice, who, during a few years at Lowestoft, spent many wonderful evenings in Dr Hutchinson's laboratory, intends to publish a volume of his photographs and some of the more interesting sections of his films, he believes that they will be of great value to students of animal life, and in addition a source of inspiration to workers in the field of photomicrography

A C H

We regret to announce the following deaths

Dr F Arnall, head of the Department of Pure and Applied Chemistry at the Cardiff Technical College, whose interest was mainly in organic chemistry, on Feb 7, aged thirty four years

Sir William Atkinson, I S O, formerly Divisional Inspector of Mines, Home Office, a past president and honorary member of the North Staffordshire Institute of Mining Engineers, on Feb 15, aged seventy nine years

Dr G G Chisholm, formerly reader in geography in the University of Edinburgh and secretary of the Royal Scottish Geographical Society from 1910 until 1925, on Feb 9, aged seventy nine years

Prof Felix M Exner, director of the Zentralanstalt fur Meteorologie und Geodynamik and professor of terrestrial physics in the University of Vienna, who was an honorary member of the Royal Meteorological Society, on Feb 7, aged fifty three years

Mr A A Campbell Swinton, F R S, known for his pioneer work on X rays and radio communication, on Feb 19, aged sixty six years

News and Views.

The problem of the structure of cellulose is one which has not only a fascination for the organic chemist but is also of the greatest importance in many industrial processes The method of X ray crystal analysis has been applied to supplement the older chemical methods, and the results of this work were set out by Sir William Bragg in a recent discourse at the Royal Institution which we are glad to be able to print as a supplement to this issue of Nature X rays have gone far to confirm modern views of the structure of cellulose and have succeeded in shedding new light on some aspects of the problem It has been shown, for example, that cellulose contains large numbers of small crystals which tend so to arrange themselves that they have one direction in common The outward sign of this selective orientation is the fibrous nature of the material In the direction of length of the fibre it is found that the atomic pattern repeats itself every 10 3 A The other dimensions of the crystal cell are less certain, but the evidence is consistent with the values of 7 9 A and 8 35 A at 84° to each other and perpendicular to the fibre axis Such a cell contains the substance of four $C_6H_{10}O_5$ groups Along the fibre direction there are chains of glucose rings (five carbons and one oxygen) linked together by oxygen atoms, the pattern repeating itself identically after every two rings, the length of which is 10 3 A One such chain starts from each corner and one from the centre of the base of the crystal cell

The structure of cellulose suggested by the X-ray examination throws light on its physical and chemical behaviour The atoms forming the chains of glucose rings along the fibres are very tightly linked together, while the chains are joined sideways by much weaker bonds due to the hydroxyl groups attached to the ring atoms. The cellulose micelle resembles a bundle of sticks, each stick strong in itself but loosely at-

tached to its neighbours The atomic arrangements and dimensions of the cell can be altered by physical and chemical means, but there is a strong tendency for the chains which lie along the axis of the fibre to remain unchanged The length of 10 3 A in this direction is affected by temperature much less than are the other dimensions Such a process as mercerisation leaves the periodicity of 10 3 unaltered, and the change accompanying this process can be explained as due to a slewing round of the chains about the fibre axis Many chemical derivatives such as nitro cellulose and acetyl cellulose show also this characteristic 10 3 A dimension, and the additional atoms introduced by the chemical actions result in an increase in the distance between adjacent chains It is interesting to note that when such atoms are removed, the structure reverts sometimes to that of the original cellulose and sometimes to that characteristic of the mercerised material

THE Council of the Royal Society, at its meeting on Feb 20, recommended for election into the Society the following fifteen candidates Herbert Stanley Allen, professor of natural philosophy, University of St Andrews, Edward Battersby Bailey, professor of geology in the University of Glasgow, Frederick T Brooks, University lecturer in botany, Cambridge, Paul Adrien Maurice Dirac, University lecturer in mathematics, Cambridge, Harold Ward Dudley, chemist, National Institute for Medical Research, Hampstead, Charles Alfred Edwards, principal and professor of metallurgy, University College, Swansea, Harry Eltringham, entomologist, Hope Collections, University of Oxford, Charles Edward Inglis, professor of mechanism and applied mechanics, University of Cambridge, Harold Spencer Jones, H M Astronomer at the Cape of Good Hope, Eric Keightley Rideal, lecturer in physical chemistry, University of Cambridge, Robert Robison, assistant chemist, Department of Biochemistry, Lister Institute, John Stephenson, formerly lecturer in zoology, University of Edinburgh, George Paget Thomson, professor of natural philosophy, University of Aberdeen, Charles Todd, Department of Experimental Pathology, National Institute for Medical Research, William Whiteman Carlton Topley, professor of bacteriology and immunology, London School of Hygiene and Tropical Medicine

ON Feb 19 an interesting lecture was delivered to the Royal Aeronautical Society by Prof Walter Georgii of Darmstadt and Mr Fritz Stamer on "Ten Years' Gliding and Soaring in Germany", and on "The Flying School at Wasserkuppe" The post-War restrictions on the use of power units for aircraft in Germany turned the attention of the younger generation in 1920 towards gliding as a substitute Since this form of flight depends on the use of slowly rising currents in the air, a practical glider is chiefly characterised by its small vertical component of velocity This is effected by reducing the total resistance, and the wing loading Thus a large span of good aspect ratio is adopted in order to give a small induced resistance. The body is closed and cantilever construction is used in order that there shall be no external bracing Launching is done by the usual method with a rubber cable, and the starting carriage is dropped In practice, in designing for low resistance, the structural weight is increased to a restricted degree and the result is to produce a medium heavy glider, with a margin of strength for high performance and for flying in gusty weather The additional weight gives greater air speed required for progress against strong winds and for passing rapidly through unfavourable belts of down winds For long distance soaring flight, a light compass and a Pitot tube are carried, but in research flights pressure gauges, inclinometers, and meteorographs are carried for recording air conditions

THE first impetus to gliding in Germany was given by W Klemperer in 1920, when he attained a glide of 2 minutes 22 seconds duration, traversing a distance of 1830 metres Progress came rapidly By 1922 gliding flights lasting more than one hour were attained Hentzen actually reached an altitude of 350 metres, remaining aloft for 3 hours 10 minutes Schultz, at Rossitten in 1924, recorded a flight lasting 8 hours 24 minutes, and in 1925, 14 hours 7 minutes This record was beaten in 1929 by Dinort with 14 hours 43 minutes It is characteristic of these flights that the best course between any two points is not necessarily the straightest, but may involve long detours in reaching up wind areas and lengthy soaring over a particular region to gain sufficient height The pilot, in fact, must fly on sound topographical and meteorological information

THE Essex Field Club commemorated the fiftieth anniversary of its foundation by a gathering on Feb 22, held in the Great Hall of the Municipal College, Stratford Among those who were present at the function were Lieut Col Sir David Prain (president elect of the Club), Sir Arthur Smith Woodward, Sir William Lister, Sir Henry Miers, Sir R Armstrong Jones, Prof J W Gregory, Prof E J Salisbury, Prof A G Green, Mr Reginald Smith, Mr J Ramsbottom, and Mr Arthur Cotton The Mayor of West Ham and the president of the Club, Mr D J Scourfield, jointly received the guests and in turn welcomed them to the function Speeches were made by the Right Hon Frances, Countess of Warwick, who made an eloquent appeal that the modern desecration of the countryside by petrol pumps and the like should be stopped by legislation, by Brigadier General Colvin, Lord Lieutenant of Essex, by Sir Henry Miers, by Sir Arthur Smith Woodward, and by Sir David Prain, each referring to those aspects of the Club's activities with which he was personally acquainted During the evening a conversazione was held, when there were many interesting exhibits of natural history objects and prehistoric relics, and an extensive series of topographical photographs and prints of Essex localities Lantern lectures were given by Mr William Glegg on "Some Features of Essex Bird Life", and by Mr S Hazzledine Warren on "The Land of Lyonesse in Essex", which were well attended Music was provided by a trio of ladies The Club's Museum, which adjoins the College, was closed to the general public on the occasion, and was inspected by the guests during the evening

The latest discoveries in the Antarctic reported in the *Times* are the result of the Norwegian expedition in the *Norvegia* Working westward from their discoveries of land adjoining Enderby Land, the Norwegians discovered a shallow bank, named after the ship, in about lat 67° S, long 32° E Bad weather and heavy ice made it impossible to find land which certainly must exist to the south The *Norvegia* therefore stood south west, and in lat 71° S, long 12° 29′ W, sighted a long chain of icebergs aground, and to the south of them shallow water extending to new land The north west point of this land is in lat 71° 26′ S, long 11° 31′ W From an aeroplane Capt Riiser Larsen and Capt Luetzow Holm charted this land for a few miles and saw it extending to the south west Part of the coast appears to be free from ice and part is faced by an ice cliff No peaks showed above the ice of the interior This new land is clearly an extension of Coats Land, which Dr W S Bruce discovered a little farther to the south west in 1904 There is little doubt that it is continuous with Enderby Land in the east

At a meeting of the Royal Society of Edinburgh on Feb 17, Prof Carl Størmer, of Oslo, delivered an address entitled "Do the Wireless Echoes of Long Delay come from Space outside the Moon's Orbit?" Prof Størmer mentioned first his mathematical researches on the aurora made in 1904, which gave among other things the result that streams of electrons sent out from the sun towards the earth could not penetrate into a certain definite region This region has the form of a tore or anchor ring which may be obtained by rotating an oval, which touches the earth's magnetic axis in its centre, round this axis This will be familiar to the readers of Nature from two letters published in November 1928 and January 1929 Prof Størmer then gave an account of the observations of long delayed wireless echoes made in Norway, England, and Scotland, and especially by a French expedition to observe the solar eclipse in Indo China in May 1929, where about two thousand echoes were observed, some of them coming 30 seconds after the signal with one third of its strength These echoes are explained by reflection of the wireless waves from currents and surfaces of electrons at the boundary or outside the above-mentioned toroidal region, and corresponding to distances from the earth several times as great as the moon's distance Prof P O Pedersen's reasons for adopting this explanation were also referred to

In his Friday evening discourse, delivered at The Royal Institution on Feb 21 on "Principles of Plant Breeding", Mr J B S Haldane said that the very numerous types of *Primula sinensis* in cultivation, including the new giant species or subspecies which is practically sterile with the ancestral form, have all arisen in cultivation in the last century They are determined by combinations of Mendelian genes, of which about thirty are known These have varied suddenly and spontaneously The laws governing their assortment in the progeny of hybrids are simple, but the result of new combinations is often unexpected. Thus, on dark stemmed plants, flowers which were expected to be a uniform blue proved to be mottled By the application of Mendelism the establishment of new races is greatly simplified, but, for the production of a first rate horticultural variety, selection is still needed The laws of inheritance in the giant subspecies, which has twice the original chromosome number, are more complicated than those enunciated by Mendel, and lead to quite different practical consequences A failure to realise these consequences has handicapped the practical breeder The application of these principles to other plants was briefly considered

A novel use of the mobility of radio communication will shortly be put into operation by the Egyptian State Telegraph Department Six radio sets mounted on three motor lorries have been ordered from the Marconi Company These sets are to be used as stations in areas not supplied by the land telegraph and telephone system This enables any place in a wide range of country on both sides of the Nile to be linked up at very short notice with the main telegraph system The motor lorries are of the six wheel type fitted with caterpillar attachments so that they will be equally mobile on hard or soft sand Each lorry will carry a medium wave half kilowatt telephone transmitter and a small portable short wave transmitter the power of which is a hundred watts The aerials are suspended from 70 ft portable masts Medium waves having lengths ranging from 600 metres to 2150 metres will be used, and also short waves having lengths ranging from 20 metres to 50 metres Egypt is a country in which, apart from the Delta, the towns and cities with their connecting railway and telegraph communications lie along a narrow strip of land bordering the Nile, with large areas of thinly populated or desert country on either side In these circumstances, these mobile radio stations should prove of value in providing extensions of the system either periodically as a regular service or in times of emergency

Engineer Rear Admiral W S Hill read a paper on powdered coal for ship propulsion to the North-East Coast Institution of Engineers and Shipbuilders on Feb 21, giving a review of the general position regarding the introduction of the use of pulverised coal afloat Particulars were given of some sixteen British and foreign vessels in which the boilers have been converted from hand firing to pulverised coal firing, or in which the boilers were originally fitted for burning pulverised coal The advantages claimed for pulverised coal are that it leads to a saving of labour approaching that saved by oil firing, that it improves the steaming of ships, and that there is a gain in overall efficiency Much depends on the actual power used for pulverising Two years ago, 25 h p per ton of coal milled was common, this figure, however, has been reduced to 14, and in a new mill about to be fitted afloat to 8 The burners have now taken a secondary place to the mill The general question of pulverised fuel burning, it may be added, is among the subjects now being investigated by the Fuel Research Board

THE Medical Research Council has appointed the following committee to advise upon the further investigation of pulmonary silicosis and of other pulmonary conditions associated with the inhalation of dusts arising from industrial processes Prof Arthur J Hall (Chairman), Dr A E Barclay, Mr J C Bridge, Prof S L Cummins, Prof E H Kettle, Dr E L Middleton (Secretary), Prof M J Stewart, Dr Cecil Wall The Committee will survey the present state of knowledge, will advise the Council upon new lines of inquiry that may be profitably pursued, and will assist in the supervision of such investigations as it may be decided to initiate or support The work will be directed particularly towards obtaining, in co operation with the Factory Department of the Home Office, more accurate knowledge of the causes and diagnosis of silicosis and of other industrial pulmonary disorders The need for better knowledge of these subjects has been emphasised by the recent Report of the Silicosis (Medical Arrangements) Committee, the recommendations of which to the Secretary of State for extended research work have been referred to the Council by the Home Office

THE second volume of the *Transactions* of the Seventh Congress of the Far Eastern Association of Tropical Medicine, held in British India in December 1927, of which the first volume was referred to in our issue of June 22, 1929 (p 954), has been issued (Calcutta Thacker's Press and Directories) It consists of 871 large pages, and comprises the proceedings of Sections III and IV Nearly a hundred papers, with the discussions to which they gave rise, are recorded in full, those of Section III deal with plague, cholera, dysentery, sprue and intestinal infections, bacteriophage, leprosy, tuberculosis, and bacteriology, while Section IV was concerned with typhus like diseases and leptospiræ, etc, protozoology, and malaria in all its aspects Malaria forms the subject of no fewer than thirty papers, leprosy takes ten, and five are concerned with the bacteriophage, an ultra virus parasitic on bacteria and provoking in them an extremely infectious disease which results in their destruction and solution The whole volume is important for all who are concerned with the cure, and especially the prevention, of disease in the tropics, and much of it is of high interest to scientific workers on more general lines The volume is well printed and the general get up excellent, it is illustrated by numerous maps and charts, as well as by twenty six plates, mostly in half tone, the reproductions of photographs which show the character of certain areas in Lower Bengal in relation to the prevalence of malaria being extremely good The editor, Lieut Col J Cunningham, is to be congratulated on the result of his labours

IN the past, submarine cables have played an invaluable part in submarine communications Until, however, the advent of 'loaded' cables, their use for telephone communication was very restricted Nowadays the distances which submarine telephone cables span are continually extending, and in a few years it seems probable that all the continents will be interconnected by a submarine telephone network We have received from Messrs Siemens Brothers and Co, Ltd, of Woolwich, a volume giving interesting particulars of some of the loaded submarine telephone and telegraph cables which they have put down In the early types of loaded cable the insulating material employed was gutta percha, but the development of submarine telephony led to the replacement of this material by paper, the resistivity of which is much greater A study of Heaviside's theories led to the adoption of the continuously loaded cable Commercial iron or silicon iron was used at first for the loading, but, as only low magnetising forces were obtainable, the increase in the speed was not great The discovery of permalloy, one of the nickel iron group of alloys which after appropriate heat treatment develops a very high permeability at a very low magnetising force and shows practically no hysteresis loss, greatly improved the quality of the loading It showed that submarine telephony over long distances was possible and greatly accelerated the speed at which submarine telegraph messages can be sent For example, in the Fanning Suva section of the Pacific cable, the speed has been increased to seven times that of the unloaded cable Particulars are given of the Isle of Man, Anglo French, Anglo Belgian, and Anglo Dutch submarine telephone cables

IN connexion with the Shannon hydro electric power station, it has been feared that the factories which will probably be built in the neighbourhood of Limerick will detract from the beauty of the west coast of Ireland At present the station helps to supply electric power to Dublin, but without the steam stations in Dublin the hydro electric power would be quite inadequate To supply power to Dublin from the station 120 miles away is not economical In our opinion, the water power available on the Liffey will sooner or later have to be harnessed for the benefit of Dublin, and possibly also the huge amount of peat available in the Bog of Allen will have to be utilised The natural place to utilise the Shannon power is along the west coast As the population increases, it is necessary to provide houses and factories for them, and many of the beauty spots will suffer In *Distribution*, the journal of Henley's Telegraph Works, for February, an account is given of the Cadbury Fry Pascall Ltd factory which was built seven years ago at Claremont, Tasmania The factory is built near the sea and is surrounded by picturesque mountains, including Mount Wellington The buildings are lighted by more than 800 windows and the floor space is 120,000 square feet A model garden village has been laid out for the workers, the cottages each containing two or three bedrooms and two sitting-rooms Tennis courts, golf links, and everything that human ingenuity can do has been done to make the workers contented The 85 motors and 12,000 lights are supplied with power purchased from the hydro-electric system Special shower baths and dressing rooms are provided for the workers, and electric lifts transport passengers and materials to the upper floors Whenever possible, Australian raw material and machinery are used There are many suitable

sites for similar factories within fifty miles of Limerick

In the second Rickman Godlee lecture delivered at University College, London, on Nov 7 last and recently published by the College, Viscount Grey of Fallodon gave a charming account of "Natural History, the Pleasure and Purpose of Observation" In simple language, more expressive than technicalities could ever be, and with many touches of humour, he pointed out the need for accuracy and caution in observation, and at the same time the danger of sterility which lies in over caution His speech itself expressed his own pleasure in the study of Nature, and this he visualised as having four aspects the pleasure in common things; the pleasure in observing changes caused by the change of the seasons and the variety of light, the pleasure of noting the recurrence of things which come round regularly, for which we have learned to care, and last, the interest in seeing something rare The address (which has been published by the College at 1s) should become a text for the teacher of nature study in schools, for if nature study could but open the eyes and minds of youth to these beauties of sense and thought, it would fulfil its main purpose of adding to the fullness and happiness of life

Among recent accessions to the British Museum (Natural History) are six photographs of East African elephants taken by Mr Marcuswell Maxwell and presented by the proprietors of the *Times* Of the collection of birds purchased for the Museum, some 300 of them, of about eighty different species, were collected by Mr G L Bates during a trip in 1928 in a part of the interior of West Africa through which no ornithologist has previously travelled The Entomological Department has received a collection of 1362 tiger-beetles from all parts of the world, presented by Mr H E Andrewes, and a collection of Coleoptera and Hymenoptera from the Algerian Sahara, numbering 1224 specimens and including the types of several new species, from Dr Ernst Hartert The most interesting acquisitions to the Department of Geology are a complete *Ichthyosaurus* on a slab of Lower Lias limestone from Street, Somersetshire, and a large collection of Permian echinoderms and brachiopods, Triassic ammonites, and Tertiary gastropods and lamellibranchs from the island of Timor. The collection of minerals has received gifts of three new species bismutotantalite, from Uganda, from the Director of the Geological Survey of Uganda, probertite, a borate mineral from California, from Prof F H Probert, and larnite, from Larne, Co Antrim, from Dr C E Tilley Recent acquisitions for the general library include Carlo Ruini's "Anatomia and Medicina Equorum nova", 2 volumes, Franckfurt am Mayn, 1603, the astronomer Olof Peter Hiorter's "Almanach för skott-ahret . 1744", an official Swedish almanack, about three inches square, with an article by Linnæus on Swedish plants, one of the only two copies known, and a copy of the anonymous skit on monasteries by the great mineralogist, Baron Ignaz von Born, in the style of a Linnæan zoological dissertation, entitled "Joannis Physiophili Specimen Monachologiæ methodo Linneana Augustæ Vindelicorum, 1783", one of three copies known

Baron Koi Furuichi, of Tokyo, has been elected an honorary member of the Institution of Civil Engineers

An earthquake was recorded at Kew Observatory on Feb 23 The first impulse was received at 18 h 23 min 50 sec G M T The epicentre was off the south of Greece near lat 37° N, long 23° E The shock was of about the same intensity as that which occurred on Feb 14 in the same region and caused considerable damage in Greece and Crete

Prof W E Gibbs, Ramsay professor of chemical engineering at University College, London, will deliver an address before the Institution of Chemical Engineers on "The Formation and Growth of Crystals", in the rooms of the Geological Society, Burlington House, London, W 1, on Mar 5, at 8 p m All who are interested in the subject are invited to attend

Recent promotions and transfers in the Colonial Agricultural and Forestry Services include the following Mr D C Edwards, agricultural instructor, Sierra Leone, to be agricultural officer, Kenya, Mr C B Taylor, superintendent, Agricultural Department, Nigeria, to be botanist, Nigeria, Mr D B Palmer and Mr L R Swindells, to be produce inspectors, Nigeria, Mr J C Rammell, assistant conservator of forests, Kenya, to be senior assistant conservator of forests, Kenya

At a meeting of the Geological Society of London, held on Feb 21, the following officers and new members of council were elected *President* Prof E J Garwood, *Secretaries* Mr W Campbell Smith and Prof W T Gordon, *Foreign Secretary* Sir Arthur Smith Woodward, *Treasurer* Mr F N Ashcroft, *New Members of Council* Prof P G H Boswell, Prof C G Cullis, Mr J F N Green, Sir Albert Ernest Kitson, and Dr Bernard Smith

At the annual general meeting of the Quekett Microscopical Club, held on Feb 11, the following officers and new members of the committee were elected *President* Mr John Ramsbottom, *Hon Treasurer* Mr C H Bestow, *Hon Secretary* Mr W S Warton, *Hon Reporter* Mr A Morley Jones, *Hon Librarian* Mr C S Todd, *Hon Curator* Mr C J Sidwell, *Hon Editor* Mr W S Warton, *New Members of Committee* Mr E A Robins, Mr F W Chipps, Mr J J Jackson, and Mr C Harvey

Applications are invited until Oct 11 next from British subjects of either sex for the Smithson Research Fellowship, which has been established under the bequest of Mr E W Smithson for research in natural science, with a view to the discovery of new laws and principles. Normally the research work of the holder of the fellowship will be carried out in the University of Cambridge The appointment will be for four years in the first instance, with possible renewals up to eight years The yearly stipend for the first two years will be £800 Copies of the regulations governing the fellowship, and forms of application, may be obtained from the Assistant Secretary of the Royal Society, Burlington House, Piccadilly, W 1

A COMPREHENSIVE and attractive tour of Great Britain and Northern Ireland has been arranged to follow the World Poultry Congress to be held at the Crystal Palace on July 22–30 The tour, which is limited exclusively to delegates, will extend from July 31 to Aug 11, and has been designed to combine a visit to places of interest to agriculturists in general and poultry farmers in particular, with a run through the beauty spots and historic centres of England, Scotland, Wales, and Ireland The project has been assisted by the Irish Free State, which has organised a tour to be taken *en route* Governments, municipalities, and other bodies will entertain the visitors The cost of the tour will be twenty-five guineas

THE Ministry of Health has issued a memorandum on the treatment of tuberculosis (*Memo* 131 B/T), being an analysis of work done during the year 1928 under the scheme of local authorities for the treatment of the disease The returns include the death rates from tuberculosis per million of population in different areas, which show considerable variations The counties with the highest rates are Durham (1059) and Cornwall (1032), while Rutland has the lowest (501) Of the county boroughs, South Shields has the highest rate (2135) and Southport the lowest (631) Gloucester and Canterbury, which might be expected to be very similar, have rates of 689 and 1235 respectively Of Metropolitan boroughs, Hampstead has the lowest rate (536) and Finsbury the highest (1639), the City of London being second with 1537 The average rate for all England is 924 Another memorandum (*Memo* 146/T) details changes necessitated by the Local Government Act, 1929, in the arrangements for the treatment of tuberculous ex-service men so far as chargeable to the Ministry of Pensions

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —An assistant bacteriologist in the Department of Pathology and Bacteriology of the University of Sheffield—The Registrar, The University, Sheffield (Mar 3) A head of the Chemistry and Industrial Chemistry Department of the Cardiff Technical College—The Principal, Technical College, Cardiff (Mar 8) A resident radiologist at St Bartholomew's Hospital, Rochester—The Secretary, St Bartholomew's Hospital, Rochester (Mar 11) A lecturer in mining subjects at University College, Nottingham—The Registrar, University College, Nottingham (Mar 15) A Montague Burton professor of industrial relations at the University College of South Wales and Monmouthshire—The Registrar, University College, Cardiff (Mar 15) A chemist in the Cereal Division of the Experimental Farms Branch, Department of Agriculture, Canada—(Particulars and application forms from The Secretary, High Commissioner for Canada, Canada House, Trafalgar Square, S W 1) The Secretary, Civil Service Commission, Ottawa, Canada (April 17) A professor of engineering at University College, Southampton—The Registrar, University College, Southampton (April 22) An assistant professor of physiology and pharmacology in the University of Alberta—The Secretary to the Board of Governors, University of Alberta, Edmonton, Alberta

Our Astronomical Column.

New Comet 1930a —The first cometary discovery of 1930 appears to have been made independently in two places (1) by Mr L Peltier, at Delphos, Ohio , and (2) by Drs Schwassmann and Wachmann at Bergedorf The following observations have come to hand from the I A U Bureau, Copenhagen, the second being made by Prof G van Biesbroeck

U T	R A 1930 0	N Decl 1930 0	Place
Feb 18d 22h 29m 4	9h 39m 40s 27	34° 46′ 11″	Bergedorf
20 4 19 9	9 22 38 93	40 21 55	Yerkes

The magnitude was given as 10 on Feb 18, and 11 on Feb 20 The deduced daily motion is $-13\frac{1}{4}$ min , North $4\frac{1}{2}$° The comet is probably fairly near the earth, from its very rapid motion Owing to its high north declination, it is observable throughout the night Mr Peltier was the co discoverer with Mr Wilk of Comet 1925 XI

The following elements and ephemeris of Comet 1930a, computed by Mr J P Möller, Copenhagen, have been telegraphed by the I A U Bureau

$$\begin{array}{ll} T & 1930 \text{ Jan } 15\ 686 \text{ U T} \\ \omega & \left.\begin{array}{l} 325^\circ\ 10' \\ 147\quad 33 \\ \ \ 99\quad 55 \end{array}\right\} 1930\ 0 \\ \log q & 0\ 03655 \end{array}$$

(with Ω on the second and ι on the third element line)

EPHEMERIS FOR 0^h U T

	R. A.	N Decl
Mar 1	7h 44m 52s	58° 24′
,, 5	7 16 24	60 58
,, 9.	6 56 0	62 24

Astro-Photography of the Future —Dr G W Ritchey contributes another article, in continuation of that referred to in NATURE of Feb 1, p 180, to *L'Illustration* of Jan 18 Several further photographs of nebulæ, both diffuse and planetary, are beautifully reproduced , all except one of these (the obscure nebula south of ζ Orionis, photographed by Duncan) are taken from his own plates obtained with the 60 inch reflector at Mount Wilson Observatory Dr Ritchey gives a brief history of our knowledge of nebulæ, and describes with a certain amount of detail the particular objects illustrated It is not clear, he says, why the chief observatories of the world, which are richly endowed, and the principal institutions formed for the advancement of science, do not unite to establish a large photographic telescope at some carefully chosen, elevated, and unpopulated place, in latitude about 25° S , where the star clouds and nebulæ of the Sagittarius region—which certainly form the most important and interesting part of the Milky Way and have been comparatively unexamined by powerful modern instruments owing to the situation of the latter in northern latitudes—could be effectively investigated If some friend of astronomy would provide the funds for such an undertaking, unsuspected and incredible discoveries would be made, to the great profit of science and education The resources and possibilities of celestial photography have scarcely begun to be explored Vital details have been almost totally neglected When they are given the attention they deserve, a new celestial photography will be born, and the results will be incomparably more useful and important for thinking humanity than those obtained up to the present

Research Items.

A Communal House on Little Andaman.—The supplement to *The Indian Antiquary* for January is an instalment of Sir Richard Temple's "Remarks on the Andaman Islanders and their Country", which consists of extracts from a report by Mr P Vaux on a reconnaissance in Little Andaman on Jan 25–Feb 4, 1902 Mr Vaux had been detailed to operate against the Jarawa This tribe lived in the then untouched forests of Little Andaman, and had not been brought under the control of the administration They indulged in periodical raids, in which murder regularly played a part Their exact location was not known, and they had proved both elusive and unapproachable Shortly after the date of this report, another punitive expedition was successful in dealing with them, but Mr Vaux was killed in the attack In this extract he describes several camps of the Jarawa, empty when he reached them, and a large communal house or camp, situated at the top of a steep hill, and approached by seven paths It was in a clearing which had been carefully prepared Several large trees had been felled, not only for space, but also to give outlook Two of the entrances had sloping log platforms to serve as look outs, and probably when the tribe was in residence (it left the camp for small hunting huts in the dry season) each entrance was guarded by similar platforms The hut was roughly oval, being sixty feet by forty feet in dimension, with a circumference of fifty four yards Seven stout posts in the centre supported the roof, and from the top of the roof between these posts were 250 pigs' skulls neatly fastened up in a basket Below the skulls was a big fireplace, while round the walls were the smaller family fireplaces, probably a dozen in number when the hut was full Each fire place consisted of four stakes driven in the ground About three feet from the ground a piece of matting fastened to the stakes formed a shelf for the meat The thatching was decorated with hundreds of fan-like bunches of leaves, and honey pots, baskets, unstrung bows, leaf water vessels, etc, hung from the roof

A Statistical Measure of Civilisation.—Dr R M Harper, in an article on some demographic characteristics of American educational centres in the February *Scientific Monthly*, describes an attempt to measure the degree of civilisation in twenty five towns in the United States in which a university dominates the life of the community Towns with large factories are excluded, and none is chosen with less than 80 per cent of white population In the average of the twenty three towns, adult illiteracy is 2 18 per cent, compared with 5 50 for the urban population of the whole country Persons per family average 3 86, compared with 4 24, children average 1 38, compared with 1 58, and males represent 47 2 per cent of the population, compared with 50 1 in the urban population as a whole This last figure is the most striking In all the towns the percentage of females is higher than that of males, while the proportions are reversed in nearly all the States in which the towns lie It should be noted that few of the actual students in the colleges come into the figures since the census enumerates them in their homes Dr Harper discusses the value of the different orders of statistics which he uses, and lays stress particularly on the sex ratio and the illiteracy count

Food of Grasshopper Mice.—Examination of the stomach content of birds has become a standard method of assessing their food, but the method has seldom been applied to mammals, perhaps because the same doubt has never arisen as to the usefulness or harmfulness of any particular species We would direct attention, therefore, to a good example of mammalian stomach content assessment, which, most unusually, sets the stamp of good-conduct upon one of the rodents Vernon Bailey and Chas C Sperry, in a thoroughgoing account of the life history and habits of the genus *Onychomys*, record analyses of 96 stomachs (U S Dept Agr, *Tech Bull* No 145, November 1929) The materials found are specified in detail and the numbers of individuals of, say, grasses or insects, are given This method is much more satisfactory than the volume percentage method which has been adopted in the United States and elsewhere for the recording of the food of birds The results were that eight ninths of the food of *Onychomys* were found to consist of animals, mostly crickets, grasshoppers, caterpillars and moths (55 8 per cent), and beetles (20 73 per cent) Cultivated grain comprised less than 5 per cent of the food, and as it consisted mostly of wheat eaten in July, it was probably waste It is seldom that a rodent does anything but harm to agricultural interests, but here is a little group of species and varieties which are economically beneficial

A Rare Cephalopod.—Mr G C Robson has described and discussed a new species of *Melanoteuthis* collected by Beebe during one of the *Arcturus* voyages (1926), from the deep waters near Cocos Island (E Pacific) ("On the Rare Abyssal Octopod *Melanoteuthis beebei* (sp n) A Contribution to the Phylogeny of the Octopoda" by G C Robson, *Proc Zool Soc London*, Oct 1929) Two specimens were obtained, and these proved so interesting that a special account is given of them apart from Dr Beebe's other cephalopods The examination of the present species throws new light on the systematic position of the genus and probably of the family Vampyroteuthidæ to which it belongs *Melanoteuthis*, although specialised in some respects, has several features which suggest that in it we see the most primitive octopod and that it retains characteristics of the common stock from which the Decapoda and the Octopoda arose Chief among these is the presence of filaments contained in the velar pouches which Joubin (1928) regards as a vestigial pair of arms —a view fully confirmed by Mr. Robson There are several distinctive features The nervous system is diffuse, the suckers pedunculate, there is a valve in the funnel and a median plate like shell rudiment, whilst there is no white body characters not found in the Octopoda but resembling the Decapoda The radula is simple and undifferentiated as in most primitive Decapoda and in *Argonauta* There are certain features which are found in the Cirroteuthidæ and some not found in the Cirroteuthidæ but found in other octopods The author suggests dividing the Octopoda into three sub orders—Vampyromorpha, Cirromorpha, and Incirrata, *Melanoteuthis* belonging to the first

Opium in the Poppy.—It was at one time thought that the elaboration of active principles in medicinal plants underwent either qualitative or quantitative attenuation when the plants were cultivated away from their natural habitat Thus, in his "Farmacopea riformata" (Venice, 1655), Quercetano states that, when transplanted into improved soil and carefully cultivated, the opium poppy becomes less poisonous This statement, often repeated, has been shown, by long series of experiments in Asia and in Europe, to be without foundation A similar conclusion is arrived at from the results obtained in the Royal Botanic

Gardens at Naples According to Cavara and Chistoni, in a paper published in the *Rendiconti dell' Accademia delle Scienze Fisiche e Matematiche di Napoli* for 1929, the morphine content of the poppy was raised, by improved cultivation and selection, from 5 46 per cent in 1923 to 10·11 per cent for the white, and to 12 14 per cent for the black poppy in 1924 Experiments on the hybridisation of the two varieties show that the opium obtained from hybrids of the fourth generation gives a high percentage of morphine The diminishing morphine content in the opium content of successive incisions is also confirmed Moreover, the occurrence of rain either during or after the incision exerts a peculiarly harmful effect, since not only does the opium lose its viscosity and consistency, but its morphine content is also greatly reduced

Indian Liverworts —The only comprehensive work upon Indian Liverworts so far has been the paper by Mitten in the *Jour Linn Soc*, **5**, 1860 Many more species have since been described, especially by Stephani, but there is much room for an illustrated account of Indian liverworts The first step towards such a publication has been taken in the issue by the University of the Punjab, Lahore, of Part I of the "Liverworts of the Western Himalayas and the Punjab Plain", by Shiv Ram Kashyap This volume deals with the Anthocerotales, Marchantiales, Sphaerocarpales and the Anacrogynous Jungermanniales The Acrogynae will be dealt with in a second volume The author hopes that later it may be possible to issue an account of the group for the whole of India, but large collections must first be made in the eastern Himalayas and South India In this work indigenous species receive fuller treatment and more figures A brief discussion of the area studied and the habitat of the liverworts is given in the introduction, whilst a full glossary and a key to the genera precedes the systematic description of species

Sylvicultural Research in India —The paper on "Sylvicultural Research in India, its Organisation, Problems, and Methods", by H G Champion, in the second issue of vol 3 of *Forestry*, should make a wide appeal to all professional foresters of the gazetted ranks and to all interested in technical forest research throughout the British Empire It may be contended without fear of contradiction that it would have proved impossible to write this paper a decade ago, and at the present day it could have only been written, for the Empire, by a research officer of the Forest Research Institute at Dehra Dun with all the data of the past history of sylvicultural research in India at his disposal, and the wide knowledge possessed by the author himself It is impossible here to do more than direct attention to this valuable paper Mr Champion discusses the present division of the work of research between the central sylviculturist at Dehra Dun and the provincial research sylviculturists who have been appointed in all the provinces of India (and Burma) with the exception of Bombay and the Punjab He also points out the necessity of selecting for such posts the best available officer and not the man who has shown himself a failure in executive or administrative work He then discusses in detail the lines upon which research work is now carried out and the enormous number of problems which such work has disclosed as awaiting solution That astonishing progress has been made during the past quarter of a century in a subject which was almost a sealed book thirty years ago the paper provides ample proof It is with no idea of minimising the value of *Forestry* to express the hope that Mr Champion's paper may be republished in such a form that it may become available to a wider circle of readers

Jan Mayen —Norwegian interest in Norway's new arctic territories in Spitsbergen, Bear Island, and Jan Mayen, is shown in the many valuable publications of the Svalbard og Ishavs Undersökelser, which appear at frequent intervals under the collective title of *Skrifter om Svalbard og Ishavet* A more popular series appear as *Meddelelser*, some of them extracted from other publications One of the latest is a small pamphlet on Jan Mayen (*Norsk Geografisk Tidsskrift*, **2**, 7), which gives a summary of the structure and climate of that island, beside a full account of its history and the seal fishing in the vicinity The paper is chiefly valuable for its full bibliography of Jan Mayen

New Cretaceous Ostreidae from Texas —Two new species of Ostreidae from the Austin Chalk of central Texas described by L W Stephenson (*Proc U S Nat Mus*, vol 76, art 18) are of particular interest, one, *Ostrea centerensis*, n sp, because it has been found abundant in a zone only a foot or two in thickness without trace of further occurrence in the beds above or below The author suggests it was a temporary immigrant from the tropical seas of the Caribbean region The other, *Exogyra tigrina*, n sp, is remarkable in that it offers one of those rare cases of the preservation of colour markings in a fossil These take the form here of brownish, radiating colour bands alternating with grey bands It recalls the similar markings on the European cretaceous *Gryphaea columba*, Lamk, cited by the late R B Newton (*Proc Malac Soc*, vol 7, p 283) when treating on the subject generally, a paper Mr Stephenson has not apparently seen

Continental Connexions in the Cretaceous —In the *Amer Jour Sci* for January 1930, Prof C Schuchert discusses the important memoir on the dinosaurs and other reptiles of the Cretaceous of the Argentine recently published by F von Huene (*Anales del Museo de la Plata*, vol 3, series 2a, p 196, 1929) Von Huene's hypothesis of an Asiatic Polynesian South American land bridge across the southern Pacific raises again the very difficult problem of how to explain the disappearance of such extensive land bridges Schuchert suggests an alternative and more probable route for Asiatic migrations through Australasia to Antarctica and thence to South America or Africa Von Huene states that South America is the home of the specialised marsupials, and that from there representatives of both diprotodonts and polyprotodonts spread to Australia but not to New Zealand Previously the monotremes and allotheres had spread from south eastern Asia to the Australian region, and from there the allotheres reached South America, which became a new development centre for them These and many other affinities, some of which are summarised in the paper, between the organic worlds of South America and the lands to the west, cannot be understood without the assumption of former land connexions, particularly in the Cretaceous At that time the larger faunal elements might have advanced by stages from Asia to South America, but, at the latest in middle Tertiary times, the continuity of the lands most have been broken through In view of Schuchert's iconoclastic attitude towards continental drift hypotheses, it is interesting to notice that he fully recognises the geophysical difficulties in the way of assuming the foundering of land bridges, and that in seeking for a connexion between South Africa and Antarctica he is not averse to admitting a certain amount of drift to the north on the part of Africa

Raman Effects in Liquids.—The issue of the *Physikalische Zeitschrift* for Dec. 1, 1929, contains a description of a new method of observing the Raman effect in liquids by Dr. R. Bär, of the University of Zurich, which gives more intense lines than previous methods and has cleared up some of the uncertainties with regard to the effect in benzol. The liquid is contained in a glass tube about a metre long, one end of which is widened into a cone closed by a glass plate, and the other drawn off sideways to a point to prevent reflection at the end. The light from a mercury lamp falls on the base of the cone and is focused by lenses at a point in the liquid near the apex of the cone, and the effect is observed from the side by means of a small mirror attached to the base of the cone at an angle of 45° to the axis of the tube. Evidence of the existence of increases of wave numbers by 605 and 990, that is, in the anti-Stokes law direction, and of decreases 2947 and 3179, was found in benzol, but none for the existence of the decreases 266, 1360, 1479, and 2630.

Mass-Spectra of Mercury, Krypton, and Xenon.—An investigation of the positive rays of mercury, krypton, and xenon, in which the relative abundance of the isotopes of these elements has been found by photometry of their lines in mass spectra, is described by Dr. F. W. Aston in the February number of the *Proceedings of the Royal Society*. Whilst mercury has been found to have an atomic weight in close agreement with the accepted value of 200·61, the number calculated from the percentage abundance of the seven isotopes being 200·62(6) ± 0·05, the results for krypton and xenon are not in accord with older determinations. Their atomic weights as deduced from their densities are 82·92 (Kr) and 130·22 (Xe), whilst those calculated from the mass spectra are 83·77 ± 0·02 and 131·27 ± 0·04. The xenon used for the density determinations had been examined by Dr. Aston with a mass spectrograph in 1922, and was then shown to be free from krypton, the only likely impurity, so that it seems possible that the reduction of the density data may have been incorrectly made. Dr. Aston mentions that the auxiliary information that is required for the accurate deduction of an atomic weight from a density is less well known than could be desired for these two inert gases, and suggests that the density determinations should be repeated, preferably with a microbalance at low pressures.

Transparent Window Glasses.—Since the discovery that ultra-violet light of wave-lengths close to 302×10^{-7} cm. would cure rickets in children, special window glasses transparent to these rays have been introduced, and as there were indications that they lost some of their transparency with use, the U.S. Bureau of Standards has investigated the properties of a number of these glasses. *Research Paper* 113, by Messrs. Coblentz and Stair, collects the results obtained. Sunlight at Washington at midday in summer contains 0·3 per cent of the curative rays, and of this the glasses in the market at the beginning of 1929 would transmit when 0·23 cm. thick and quite new from 63 to 48 per cent. After exposure to sunlight for a summer or to the light from a quartz mercury arc for 10 hours, their transmission had fallen to 49 and 23 per cent respectively, and remained approximately at those values on further exposure. A much more serious reduction is produced if the surfaces of the glass are not kept clean and free from dust.

Formation of Nitric Oxide.—Following on a recent statement that the yield of nitric oxide formed in the arc is increased if carbon dioxide is present, Tartar and Hoard, in the January number of the *Journal of the American Chemical Society*, describe some careful experiments on this reaction. They find that, with currents of 65 milliamp., only one-sixth the concentration of nitric oxide is produced from a mixture of nitrogen and carbon dioxide as is produced from air, and the effect of reduced pressure is very slight. An increase in the yield was obtained by increasing the current by 50 per cent. The authors conclude that the reaction offers little promise as a method of nitrogen fixation in the arc.

Measurement of Coal Dust Inflammability.—One of the gravest hazards of coal mining—the coal dust explosion—is now recognised and countered by the process of stone dusting the underground passages. Coals differ in inflammability, and in order to apply the remedy rationally a method has been devised which is described in the *Safety in Mines Research Board Paper*, No. 56, by A. L. Godbert and R. V. Wheeler (London: H.M. Stationery Office), whereby this property can be gauged in the laboratory. It consists in determining the proportion of inert dust necessary to suppress inflammation when small quantities are blown by oxygen through a heated tube. The results are comparable with those given by trials in an explosion gallery. By means of the test it was shown that the inflammability roughly increased with the content of volatile matter of the coal and more precisely was associated with the reactivity of the ulmin contents.

Ignition of Gases by Electric Spark.—The problem of discovering the exact process which takes place when a combustible gas is ignited by an electric spark is one of great importance in motor car engineering. There are, however, so many variables to be considered when a magneto is employed for producing the spark that little progress has been made towards getting a solution. A paper by Messrs. Terada, Tumoto, and Yamamoto on the difference in the behaviour of different parts of a 'three-part spark' in igniting combustible gas mixtures, which is published in the *Scientific Papers of the Institute of Physical and Chemical Research, Tokyo*, p. 132, 1929, is of value in this connexion. They experiment on the spark obtained between equal spheres when the lead of the positive electrode is earthed or provided with a corona leakage from a needle point. The electricity was continually applied by a statical machine. In this case, when the spark gap is about three times the diameter of either sphere, it is divided into three distinct parts which are quite different from one another and are called the positive, middle, and negative parts. The middle part is the most luminous, and its spectrum shows the head of the second positive band of nitrogen superposed on a continuous spectrum. The other parts give the ordinary spark spectrum of air together with some metallic lines. Tests were made to find out the igniting power of different parts of the spectrum. A fine jet of the combustible gas being experimented on was directed towards different parts of the jet and the number of ignitions that followed was noted. The frequency of the ignitions was much the greatest in the middle of the arc and was least at the junctions of the middle part with the positive and negative parts. Since the duration of the discharge in the middle part of the arc was only about a tenth of the duration of the positive and negative parts, it was not a cumulative time effect. There is a decided difference in the mode of excitation of the molecules in the different parts of the arc, and this has a great effect on its igniting properties.

Progressive Chemistry

THE *Journal of Chemical Education*, a beautifully printed and illustrated monthly magazine of some two hundred pages, conveys a striking and even startling impression of the popularity and progress of chemical studies in the United States. The journal, which costs two dollars fifty cents per annum, is the official organ of the Division of Chemical Education of the American Chemical Society, and its aim may be expressed in terms practically identical with those which are applied in the January issue to the closely related Chemical Foundation Inc., that is, "the advancement and maintenance of chemical education in the United States to the plane where we shall have not only the best chemistry teachers and methods of teaching this science in the world, but also have the most enlightened lay people who will appreciate the importance of the application of chemistry in all phases of life and industry."

The staff of the journal includes six departmental editors and more than sixty contributing editors; in addition to the latter there are sixteen abstractors. Among the dozen foreign editors we notice the names of Sir James Irvine (St. Andrews), Prof. F. G. Donnan (London), Prof. K. Freudenberg (Heidelberg), Prof. E. Cohen (Utrecht), and Prof. W. D. Treadwell (Zurich). The thorough way in which the Division of Chemical Education of the American Chemical Society has set about its duties is evident from the lists of committees, members of the Senate of Chemical Education, and local organisations operating in the various States. The twelve committees upon the current list are concerned with such subjects as aids to visual instruction in chemistry, chemical education of the non-collegiate type, correlation of high school and college chemistry, labels, professional spirit among high school teachers, research problems, and women's club study course in chemistry.

The editorial article of the January issue contains some interesting references to Benjamin Silliman (1779–1864), the first professor of chemistry at Yale, who took up the duties of the chair in 1804. "America's first great scientific publicist", in his early days at Philadelphia, was acquainted with Hare and Priestley the chemists, Wistar the anatomist, Barton the botanist, and Seybert the mineralogist; he therefore links these names with those of his own eminent pupils of a later age, among them "Dana, world renowned geologist and mineralogist; Brush, whose exhaustive mineralogical chemical studies are authoritative everywhere; Johnson, pioneer leader in chemistry applied to agriculture; Willard Gibbs, first among physical chemists of modern times; T. Sterry Hunt, profound in chemical philosophy and theory." There are articles on the tung oil tree (with some good coloured plates), the teaching of electrochemistry (a symposium presented before the American Electrochemical Society at Toronto, in 1929), educational activities of Mellon Institute, and chemical warfare.

Among other features, there are contests for students, notices of new books and scientific articles in magazines, and illustrated abstracts of interesting papers from current chemical and educational journals—including a section entitled "Keeping up with Chemistry." "One of the hardest and most disappointing things is to endeavour to retain an active interest in chemistry after one has graduated," is the complaint of a writer in the December *Alchemist*, the official organ of the Glasgow University Alchemists' Club. This very real difficulty would be overcome if chemists in Great Britain could develop sufficient enterprise to publish a British counterpart to the lively and stimulating American *Journal of Chemical Education*, which is now in its seventh year.

Stellar Velocities and Stellar Physics

AT the annual meeting of the Royal Astronomical Society on Friday, Feb. 14, the president, Dr. A. C. D. Crommelin, delivered an address on the work of Dr. J. S. Plaskett, director of the Dominion Astrophysical Observatory, Victoria, B.C., to whom the Gold Medal of the Society has this year been awarded "for his valuable observations of stellar radial velocities and the important conclusions derived from them." The award, said Dr. Crommelin, was made "not for any single outstanding result, but in recognition of the high merit of a long series of researches, extending over a quarter of a century, and marked throughout by a painstaking striving after the highest accuracy attainable, combined with an alertness in discerning problems of stellar motion and stellar physics to which the powerful observational means available might most suitably be applied".

Dr. Plaskett's astronomical career began in 1905 at the Ottawa Dominion Observatory, where he was placed in charge of the Department of Astrophysics. His early work included the determination of stellar radial velocities for various purposes, but the instruments at his disposal would not permit of an extension of the work beyond stars of the fifth magnitude. It soon became clear to him that the greatest need in this work was the examination of fainter stars, and the possibility of obtaining a telescope of larger aperture than those he had up to that time employed began to occupy his thoughts. During a visit to Mount Wilson in 1910 to attend a meeting of the Solar Union, the desire to obtain such an instrument was greatly intensified by an appeal from Prof. Campbell for co-operation in determining the radial velocities of the fainter stars. Dr. Plaskett conceived the idea that Canada might distinguish herself among the nations by erecting a giant reflector for spectroscopic research, and on returning to Ottawa he laid his scheme before his director, Dr. W. F. King, who endorsed it with enthusiasm. Mainly through Dr. Plaskett's efforts, the 73-inch telescope—the largest in the British Empire and the second largest in the world—was erected at Victoria, and he was appropriately appointed as the first director of the new observatory established at the same time.

Of the large amount of important work which has been done both by Dr. Plaskett himself and by assistants under his direction, arising from the extended programme of radial velocity determinations thus made possible, the outstanding results relate to the study of the high temperature *O* type stars, the character of the interstellar calcium cloud, and the rotation of the galaxy. Among the *O* type stars, particular interest attaches to 'Plaskett's star', a binary the components of which are respectively at least 86 and 72 times as massive as the sun. These are easily the largest figures for stellar masses so far found in our sidereal system. Dr. Plaskett assumed, in the absence of evidence to the contrary, that the stars, as seen from the earth, do not eclipse one another in their mutual revolution, but Dr. Crommelin gave reasons for doubting this. If it should be established from variation of the light that eclipses take place, more precise values of the masses will be obtainable.

The systematic investigation of the 'stationary' ionised calcium lines in the spectra of hot stars which Dr Plaskett carried out led to the first clear demonstration that the material responsible for these lines had no motion with respect to our system of stars His earlier suggestion that it was originally discharged by the hot stars and came to rest some distance away from them probably needs modification in view of the evidence for Eddington's hypothesis that the matter is distributed throughout interstellar space, and indeed Dr Plaskett, in a very recent paper, has himself given some of the strongest evidence for the latter view by showing, from the consideration of three separate groups of stars, that the average distance of the cloud is half that of the stars in the spectra of which its lines appear It must be remembered also that Eddington's work in this connexion would not have been possible but for the thoroughness and accuracy of Plaskett's original investigation

The idea that the galaxy is rotating is not a new one, but the evidence for some former ideas on this matter is now known to be spurious The subject has lately come to the fore again through the realisation that our stellar system is probably a spiral nebula, and therefore is in all probability rotating in the manner which the appearance of those bodies forces us to admit Specific evidence for the rotation recently came from Oort and Lindblad, and Dr Plaskett at once perceived that his radial velocity measurements could throw an important light on the matter He analysed the motions of the distant stars—those of types *B* and *O*, of which he had made a special study—and was able to show that they gave clear indications of rotation about a centre in galactic longitude 324 5°, which agrees with the position given by Oort and also with that found by Shapley for the centre of the galactic system from totally different considerations based on the distribution of globular clusters The centre of the galaxy is near the junction of the constellations Sagittarius, Ophiuchus, and Scorpio, in a 'rift' between two branches which is probably caused by obscuring matter hiding from us what would otherwise be the brightest part of the Milky Way Dr Plaskett's contributions to the elucidation of this problem have been characterised by the solidity and thoroughness which he has shown throughout his career, and his results, however their interpretation may vary, are permanent

Dr Plaskett, who has been invited to give the George Darwin lecture of the Royal Astronomical Society, has chosen as his subject "The High Temperature Stars" The lecture will be delivered on May 9, and will contain some hitherto unpublished material on these important bodies

River Flow Records in the Ness Basin, Scotland

TO those interested for scientific and technical reasons in the availability of trustworthy data respecting river flow in Scotland, the appearance of two unostentatious pamphlets,[1] or monographs, containing records during recent periods of the Rivers Garry and Moriston, both in the Ness Basin, Inverness shire, will be welcome not merely for the records themselves and the information they afford at the moment, but also as indicating the inauguration of a series of observations which, if continued and extended over a period of years, cannot fail to be of considerable value when the time arrives for dealing with questions of river development

Capt W N McClean, at his own pains and expense, in conjunction with some voluntary helpers, has set on foot the systematic collection of hydrological data which no public or authoritative body in Scotland (or indeed in Great Britain) is empowered or disposed to undertake It is true that the Scottish Meteorological Department in Edinburgh has shown itself helpful in certain directions, and that it receives rainfall returns and provides general supervision over their collection, but the brunt of river gauging work falls at present on the private investigator "River Flow Records", the organisation of Capt McClean and his fellow-workers, is therefore an undertaking in the public interest which is deserving of acknowledgment for its altruistic labours The quarterly reports, which are on sale at a nominal figure, are distributed not only to all who have given facilities for, or assistance in, the taking of measurements, but also "to others who it is hoped will help in assuring continuous measurements of the water resources of the country"

The two rivers which form the subject of the monographs have equivalent catchment areas, but some appreciable variation in rainfall The River Moriston has a catchment area above the gauging section of 149 square miles, and the River Garry an area of 148 square miles. For both rivers, therefore, a flow of 400 cusecs is equal to 0 1 inch per day on the catchment area The flow off of the Garry, however, is considerably greater than that of Moriston on account of the larger area under heavy rainfall at the headwaters of the former For the two months of August and September in the period under review the ratio was as much as 3 to 2

The comparison of flow off and rainfall for the Moriston covers a period of a little more than nine weeks in the autumn of 1929 (July 27–Sept 30) based on actual measurements of flow made between Sept 13 and Sept 26 These few measurements, Capt McClean considers, are sufficient to enable a fair estimate to be made of the flow near Invermoriston from a moderately low river to a considerable flood, and permit of a rough prediction of flow for any recorded river height In default of more extended observations, the figures in the tables undoubtedly will be helpful, but it is obvious that there is need to supplement and compare them with later readings over a longer period, in order to increase the range, to eliminate errors, and to secure closer approximations

In the case of the Garry, measurements of flow were made between Aug 27 and Sept 11, 1929 Here, too, the records are for a very short period, but the author points to the observations which he kept of water level and rainfall during the three years 1913–15, the results of which were published in the *Proceedings of the Institution of Water Engineers* for 1927 The present records, therefore, are a resumption of the work previously carried on and unfortunately interrupted It is of interest to note that the flow of the Garry does not change with the rapidity of that of the Moriston on account of the long narrow exit from Loch Garry The loch rises gradually and has risen as much as 20 feet, storing at that level the equivalent of 3 inches of rainfall over its feeding area As a consequence, floods below the loch are delayed and spread over a long period

It is understood that not only are the present records to be continued, but also that similar readings and measurements are contemplated for other streams in the Ness Basin, including the Rivers Oich and Ness

BRYSSON CUNNINGHAM

[1] River Flow Records, Ness Basin River Moriston and River Garry Reports on River Flow, July to September 1929 Each 4 pp + 3 tables (Parliament Mansions, Victoria Street, S W 1) 1s 6d each

University and Educational Intelligence.

BIRMINGHAM.—The Huxley Lecture is to be delivered on Mar. 6 by Sir William B. Hardy, Director of Food Investigation, Department of Scientific and Industrial Research, who has chosen as his subject "The Physical Basis of Life."

OXFORD.—For some time past questions of library accommodation and administration have been keenly discussed in Oxford. Some of the difficulties of the situation have been met by placing certain of the special book collections, for example, the Radcliffe Scientific Library, under the jurisdiction of the Bodleian. But it is felt that a complete reorganisation of the whole library system, including structural enlargement, arrangements for accessibility, facilities for readers and workers, the acquisition and proper housing of books, is urgently required. For this reason the generous offer of the Rockefeller Foundation to defray the expenses of a commission to visit modern university libraries and to report on their organisation, planning, equipment, and administration is especially to be welcomed. The commission, after finishing its inquiry, will be in a position to advise the University as to the best methods of bringing its library provision into agreement with modern requirements.

The annual report of the Visitors of the University Observatory has just been published. It contains a record of much work on the zones of the Astrographic catalogue and on seismological results up to 1926, including Prof. H. H. Turner's analysis of the earthquakes in the Philippines. A list is given of important papers by Prof. Turner and members of his staff that have appeared since the last report.

THE Borough Polytechnic, in Borough Road, London, was honoured on Feb. 20 by a visit from the Duke of York, on the occasion of the opening of its new buildings; this being the culmination of a series of similar functions which began with the opening last October by the Queen of the extension of the Regent Street Polytechnic. The Borough Polytechnic, the oldest and still the largest of the group of institutions founded under the scheme drawn up forty years ago by the South London Polytechnic Council, was opened by Lord Rosebery in September 1892. During the last seven years the volume of its work has increased by fifty per cent, and additional accommodation, for which the London County Council gave grants amounting to £80,000, had become urgently necessary. Even now, pressure on the available accommodation is excessive. The class entries total nearly 10,000, as follows: day schools, 568; day classes, etc., 287; evening departments of mechanical engineering and building, 1918; electrical engineering, 2068; chemistry, 667; chemistry of oils, colours, and varnishes, 401; mathematics, 893; tailoring, 126; bakery and confectionery, 308; art classes, 469; women's trade classes, 303; women's domestic economy classes, 664; language classes, 295; music and elocution, 374; gymnasia, 495. To the question "What can science do for industry?" many and various answers have in the course of the past few weeks been broadcast. The Duke of York dwelt, in his address, on a branch of science the votaries of which can indeed, albeit indirectly, through wise direction of consumption and beneficial influence on the moral and physical welfare of the personnel of industry, give more potent help than any other—domestic science with its correlative crafts. He commended the care taken by the Polytechnic in instructing girls and young women in the sciences and arts that make for the building up of good and comfortable homes.

Historic Natural Events

Mar. 3-4, 1886. Hurricane in Fiji.—This very severe hurricane caused the loss of many lives and the destruction of much valuable property, and was the worst experienced for many years. It travelled from north east, across the centre of the group, recurving over the Koro Sea and passing away to the south east, at an average speed of nearly 15 miles per hour. It had a calm centre with a diameter of 25 or 26 miles, in which the barometer fell to about 935 mb. (27.6 inches). Near the vortex the barometric gradient was 33 mb. (nearly one inch) in 50 miles. The town of Vuna in Taviuni was completely wrecked; nearly all the houses were blown down, and then were swept away by a hurricane wave or buried in the sand and shingle. From the coast to the tops of the hills nothing remained but bare sticks and the blackened, torn, and twisted relics of the foliage. Most of the small islands suffered from the storm wave, which came in like a wall, and penetrated inland as much as 700 yards. In some places debris was left in the trees 30 feet above high water mark. At Vanuaso a shark was killed among the houses.

Mar. 5-7, 1595. Great Floods.—The winter of 1594–95 was very severe; all the rivers of western and central Europe were frozen hard, including the Po and the lagoons of Venice. There was a great accumulation of snow, which began to melt rapidly at the end of February during a period of thaw; this and the break up of the ice caused great ice floods in the valleys of the Rhine, Moselle, and Elbe, which broke down the strongest stone bridges. The Thames was frozen, but there is no record of flooding in London.

Mar. 6, 1716. Remarkable Aurora.—A detailed account of this wonderful aurora was drawn up by Halley at the request of the Royal Society, and is published in *Phil. Trans.*, 1716, p. 406, under the title, "An Account of the late surprising Appearance of the Lights seen in the Air, on the sixth of March last; with an Attempt to explain the Principal Phænomena." This aurora was seen from almost the whole of northern Europe and so far south as the north west coast of Spain. In England the display commenced at 7 P.M. and lasted until 3 A.M. on the following morning when the moon rose. The most spectacular phase was from 7 P.M. until about 9 P.M., including the short lived appearance near the zenith of a 'corona' tinged yellow, red, and a dusky green. Throughout, the display was remarkable for the variety and rapidity of its changes as well as for its brilliance. Halley remarks: "Nor is the like recorded in the English Annals since the year of our Lord 1574"; also "... it seems, in little more than eighteen months, this sort of light has been seen in the sky, no less than five times; in the years 1707 and 1708." *Phil. Trans.*, 1716, p. 430, gives an account of the recurrence of the aurora on Mar. 31, April 1 and 2, 1716, *i.e.* about one solar rotation later. Wolf found that during the period 1716–19 sunspots were unusually numerous, though no large spot appears to have been observed about the time of this aurora.

Mar. 7, 1925. Abnormal Rains in Peru.—The coastal regions of Peru are in general almost rainless; for example, at Trujillo in the seven years 1918–24 inclusive, the total rainfall was only 1.4 inches. On Mar. 7-9, 1925, however, no less than 8.9 inches fell, and by the end of the month the total had risen to 15½ inches. Similar abnormal rains occurred all along the coast, beginning in January but reaching their maximum in March. Great floods resulted, doing serious damage to buildings, machinery, roads, and crops. The normal absence of rain is associated with the presence off the coast of the cold Humboldt

current, but at rare intervals a warm current, known as El Niño (The Child), because it usually appears about Christmas, flows down the Peruvian coast Early in 1925 this warm current was abnormally developed, temperature rose 10° or 20° higher than usual, and violent thunderstorms occurred

Mar 7, 1927 Earthquake in Tango District (Japan) —A strong earthquake occurred in the Tango peninsula on the north side of the main island of Japan The number of lives lost was 3017, while several small towns were ruined Crust displacements took place along two old faults nearly at right angles to one another On the Go mura fault, the ground shifted, along 11 miles, by so much as 9 ft 2 in horizontally and 2 ft 7 in vertically Repeated surveys in the central tract showed that movements continued for a year or more, and that the crust was divided into a number of blocks that moved easily and not always in the same directions

Mar 8, 1920 Haloes in America —A very fine display of solar haloes began at 11 30 A M at Ellendale, South Dakota, and other parts of the central United States In addition to the haloes of 22° and 46°, there were visible circumscribed arcs, parhelia, anthelion of 180°, and other phenomena, some of which exhibited brilliant prismatic colours The phenomena awakened great interest in the subject in America

Mar 8 (or 10), 1543 Mississippi Flood —The history of De Soto's expedition on the North American continent states "Then God, our Lord, hindered the work with a mighty flood of the great river, which at that time began to come down with an enormous increase of water, which in the beginning overflowed the wide level ground between the river and the cliffs, then little by little it rose to the top of the cliffs Soon it began to flow over the fields in an immense flood, and as the land was level without any hills, there was nothing to stop the inundation On Mar 18, 1543, when the Spaniards were marching in procession, the river entered with ferocity through the gates of the town of Aminoya (a short distance below the mouth of the Arkansas River), and two days later they were unable to go through the streets except in canoes The flood was 40 days in reaching its greatest height, which was April 20, and it was a beautiful thing to look upon the sea where there had been fields, for on each side of the river the water extended over twenty leagues of land, and all of this area was navigated by canoes, and nothing was seen but the tops of the tallest trees"

Societies and Academies.

LONDON

Royal Society, Feb 20 —**A C Davies, F Horton, and E Blundell** Critical potentials for the excitation of soft X-rays from iron Critical potentials for excitation of soft X rays from solids, and for production of secondary electrons from solids, under electronic bombardment, do not conform with the view that characteristic displacements take place of electrons forming the outermost extranuclear groups in the bombarded atoms The experiments deal with critical potentials for soft X ray excitation from iron, rolled into thin strip from a drawn wire, for different temperatures and also for the same specimen at room temperatures, after being subjected to various heat treatments Many critical potentials were produced, mostly persisting throughout the subsequent conditions of the target, once they had made their appearance, only one—at 201 volts—justifies the conclusion that its presence was dependent upon the iron strip being at a high temperature —**L M T. Gray and D W G Style** The absorption of light by chlorine, bromine, and their gaseous mixtures The independence of the absorption of chlorine of the intensity or nature of the incident radiation was tested by various methods Extinction coefficients of bromine vapour have been determined at room temperature for certain mercury arc lines The absorptions of mixtures of chlorine and bromine confirmed the existence of BrCl

Linnean Society, Jan 23 —**H W. Renkema and John Ardagh** Aylmer Bourke Lambert and his 'Description of the Genus *Pinus*' Lambert was the son of a country gentleman, of Boyton, Wiltshire Among his friends at Oxford, where he matriculated in 1779, were Joseph Banks and the principal founder, in 1788, of the Linnean Society, James Edward Smith Lambert was an original fellow of the Society and for fifty years was vice-president His chief contributions to botanical science were the accumulation of a large library and herbarium, and the spacious monograph of the genus *Pinus* A detailed description was given of the contents of all the copies of the volumes of the various editions to which the authors, in Holland and London respectively, have had access or on which they have been able to obtain reliable information —**G Tandy** Sundry observations on *Caulerpa* On the low wooded islands and inner reefs of the Australian Great Barrier system, two species are of importance as sand and shingle-binders, and it is probable that nowhere else in the world are conditions so favourable for this habit They are in the broad sense (for they are polymorphic) *C racemosa* (Forsk) J C Agardh and *C cupressoides* (Vahl) C A Agardh The latter is common on Batt Reef, which belongs to an inner series and is not a linear or true barrier reef The former is very common on Low Isles and is a member of the turf of the mangrove park.

Physical Society, Jan 24 —**J M Nuttall and E J Williams** A method of examining stereoscopic photographs The photographic plates are replaced in the cameras and illuminated, and a system of movable pin points is used to trace out the contour of the image (see NATURE, May 25, 1929, p 799) The chief advantage of the method is its simplicity—practically no computation is required and it is not necessary to know the stereoscopic angle, the magnification, etc —**Miss A W Leyshon** Characteristics of discharge tubes under 'flashing' conditions, as determined by the use of a cathode ray oscillograph Current voltage characteristics are determined Current time and voltage time curves are derived from the oscillograph records The method might prove useful in investigations on intermittent discharges in various gases under different conditions of pressure and disposition of the electrodes

Royal Meteorological Society, Feb 19 —**G C. Simpson** The distribution of terrestrial radiation (*a*) The geographical distribution of incoming and outgoing radiation during January and July has been determined and was exhibited on maps (*b*) The incoming and outgoing radiations for each 10° zone of latitude have been calculated for each month of the year (*c*) The result indicates great uniformity in the intensity of the outgoing terrestrial radiation, both in time and space, and that, except for small uncertain irregularities, the total outgoing radiation from the earth as a whole just balances the incoming solar radiation at all periods of the year —**C K M Douglas** The cyclonic depressions of Nov 16 and 23, 1928 Autographic records are reproduced showing the conditions close to the

centres of these two intense cyclones In both cases the first cold front soon advanced beyond the trough line of the cyclone This happens with nearly all intense cyclones, owing to the fact that the gradient wind behind the cold front is much greater than the rate of travel of the cyclone itself, even when this is large The speed of advance of these cyclones was greater than that of the general current in which they travelled This 'excess velocity' is characteristic of systems with warm sectors

DUBLIN

Royal Irish Academy (at Belfast), Feb 10—**K G Emeléus** Velocities of ions in the cathode dark space Existing data for the distribution of velocities in positive rays are discussed with the view of obtaining the distribution at the front surface of the cathode, little definite information is obtained, but an analogy is found between the capture of electrons by protons and by α particles The distribution at the cathode is calculated from Aston's and Brown and Thomson's results for the space charge in the dark space The possible effect of the cathode glow in distributing the velocities of particles traversing it is discussed, with the bearing of the results on sputtering—**A Mahr** The Viking sword from Ballinderry, Co Westmeath The blade shows the inlaid name of the maker, Ulfberht, a well known Frankish smith whose blades have been found scattered from France to Esthonia Another name, Hiltipreht, appears on the silver gilted quillon The name is Bavarian or Austrian, and Hiltipreht must have worked somewhere on the Low Rhine, where the Norsemen got their first supply of such weapons Hiltipreht was not the owner but the cutler of the sword In 841 the Vikings destroyed the famous town Wijck bij Duurstede in South Holland, at the time the important emporium for Scandinavian trade Our sword was presumably then brought to Norway and from Norway to Ireland Thorgestr, first Norwegian King of Dublin, raided Clonmacnois in 843, and as the Ballinderry Crannog is only a few miles distant we may assume that the sword came into Irish hands on this occasion—**J K Charlesworth** Some geological observations on the origin of the Irish fauna and flora During the glacial period, life was impossible in Ireland and off the western coast and just possible in the case of Arctic forms off the southern coast A fauna and flora entered over a land connexion during the Aurignacean oscillation, but with the exception of the Arctic species was probably exterminated during the succeeding glaciation The greater part of the Irish fauna and flora entered post glacially by a land bridge, aided by accidental dispersal

PARIS

Academy of Sciences, Jan 20—**Charles Moureu, Charles Dufraisse, and Pierre Lotte** The phenomena of luminescence in the satellites of rubrene Two phosphorescent hydrocarbons the so called 'brown' substance and the yellow substance—**Jean Baptiste Senderens and Jean Aboulenc** The catalytic de hydration of the fatty alcohols by alkaline bisulphates The boiling points of the first members of the series up to isobutyl alcohol are too low for any reaction with sodium bisulphate to take place, but from isoamyl alcohol onwards mixtures of ether and hydrocarbon are obtained Normal heptyl alcohol gives heptyl ether without heptylene—**Marcel Delépine** was elected a member in the Section of Chemistry, in the place of the late Charles Moureu—**L Godeaux** The connected points of cyclic involutions belonging to an algebraic surface—**P Vincensini** Certain normal congruences—**Bertrand Gambier** Systems of circles, of spheres, and of hyperspheres—**Pierre Humbert** Bessel functions of the third order—**K Kunugui** The classes of dimensions—**J A Grégoire** A new mode of transmission of rotations with conservation of the velocity between two shafts with variable angle Hooke's joint, a combination of two Cardan's joints, although theoretically perfect, gives rise to practical difficulties The new joint proposed is theoretically homokinetic, and has been practically realised in connexion with motor cars—**Renaux** Contribution to the study of the reduction of photographic negatives Discussion of a method of studying the position of stars from photographs—**J Dufay** A new astronomical photometer application to the study of two variable stars with eclipses—**J Galibourg** The ageing of cold hardened metals A continuation of the study of the effects of cold hardening on nickel—**P Vaillant** The absorption of cobalt salts in concentrated solutions From the whole of the experimental results obtained, it is concluded that for solutions of cobalt salts the modifications arising in the absorption spectrum from the substitution of one anion for another, from a change of concentration, or from a change of solvent, can be reduced to a Kundt displacement and a change of intensity These results are not necessarily in disagreement with the ionic theory—**P Dutoit and Chr Zbinden** The spectrographic analysis of organs The ashes of about fifty human organs have been submitted to spectrographic analysis by the arc spectrum method a summary of the results is given—**Edlén and Ericson** The spectrum of aluminium in the extreme ultra violet—**E Sevin** The means of deciding between the corpuscular nature and the purely undulatory nature of light and of the X rays—**Fahir Emir** Surface solutions on mercury Study of oleic acid A description of the special precautions taken to prevent oxidation of the mercury surface The thickness of the saturated film found was 24 A, as against 23 A found previously for water This confirms the hypothesis of molecular juxtaposition at the point of saturation—**Victor Henri** The heat of dissociation of the molecule of oxygen and the energy of activation of the oxygen atom From work based on the study of the absorption spectrum of nitrogen peroxide, the energy of the normal dissociation of the oxygen molecule is deduced as 128,000 calories—**Mlle Suzanne Veil** A mixed nickel cobalt oxide and the corresponding ferrite—**L Meunier and M Lesbre** A new method of observation of the evolution of solutions of chromic salts—**R Bernard and P Job** The oxidation of cobalt salts in alkaline media From a spectrophotometric study of this reaction, it appears that the passage from the cobaltous to the cobaltic state is through the intermediary of a percobaltic compound, CoO_2, in which the cobalt is tetravalent—**J Grard** Bromomalonic dialdehyde This exists in the forms CHO CHBr CHO and CH(OH) CBr CHO, the second of these possesses acid properties and gives well crystallised metallic salts—**L Palfray and B Rothstein** The 1, 3 cyclohexanediol (resorcite) stereochemical isomers and halogen derivatives—**F François** The selenoxanthydrols Their basicity The replacement of the oxygen of xanthydrol by selenium does not change the basic character of this alcohol—**H Besairie and Mlle E Basse** New stratigraphical and palæontological observations on the lower and middle Cretaceous of the province of Maintirano (west of Madagascar)—**Raymond Furon** Some new points of the geology of the western Sudan (Diawara, Kaarta, and Fouladougou)—**Laurent Rigotard** The rôle of sulphur in the formation of plant soil A study of the part played by sulphur in the formation of Alpine soils—**Louis Dangeard**: The presence of *Solenopora* in the oolitic and pisolitic formations of

the Lusitanian of Mortagne (Orne) —**M. Bridel and C. Charaux** Researches on the variation of the coloration of plants in the course of drying A new chromogen, oroberol, extracted from *Orobus tuberosus* —**B Soyer** The variation of the permeability of the cells in the course of growth in a ligneous plant Measurements of the permeability of the plant cell show that the migrations in spring and autumn are accompanied by marked modifications in the cellular permeability, modifications facilitating the circulation of the liquids in the tissues —**P Chevey** The value of the method of examination of the scales applied to fishes of the intertropical zone A difference of only 4° 5° C between the summer and winter temperatures of the sea is sufficient to change the rate of growth of fishes as shown on the scales Conclusions are drawn regarding the thermal changes in the coastal waters of Siam, Cochin China, and Tonkin —**J Millot** Colulus and non functional fibre producing structures in the Araneideæ —**C N Dawydoff** Some observations on the *Ctenoplana* of Chinese seas —**L Garrelon, D Santenoise, H Verdier, and M Vidacovitch** The pancreas and pneumogastric excitability The pancreas exerts an important action on the functional activity of the growing nervous system, by secreting and pouring into the blood a vagotonising hormone not identical with insulin —**René Hazard and Michel Polonovski** The physiological rôle of the tertiary amine function in the pyrrolidine piperidine nucleus The importance of the idea of isomerism —**R Meesemaecker** A new colour reaction of ergosterol The differentiation of ergosterol from irradiated ergosterol The colour is developed by addition of anhydrous zinc chloride, with or without acetic anhydride, to the ergosterol in chloroform solution With zinc chloride alone, the colour depends on whether the sample has been exposed to light or not —**L Lutz** The soluble ferments secreted by the Hymenomycetes Hydrocarbons and terpene oxides, constituents of the essential oils and the antioxygen function —**M Azéma and H Pied** Vanadium in the blood of Ascidians The presence of vanadium in the blood of *Phallusia mamillata*, first discovered by Henze, is confirmed, and two other Ascidians, *Ascidia mentula* and *Phallusia fumigata*, also gave strong spectroscopic evidence of the presence of vanadium *Botrylloides* and *B smaragdus* also contained vanadium, but in smaller amount —**Constantino Gorini** Heterogeneous mammary cocci, their dissociation —**E Piantureux** The nature of the transmissible lysis of bacteria —**Arnault Tzanck and Jean Charrier** The treatment of grave hæmorrhage of different forms

Brussels

Royal Academy of Belgium, July 6 —**Cl Servais** The geometry of the tetrahedron (3) The congruence of the axes of symmetry of the paraboloids conjugated to a tetrahedron —**Th de Donder** Affinity (2) Study of physico chemical systems with the added condition that the masses may vary —**Th de Donder** The invariantive theory of the calculus of variations (6) —**André Jamotte** Note on the discovery of a *Glossopteris* flora in the Lukuga valley, in the neighbourhood of Greinerville (Belgian Congo) The flora described shows great affinities with that of the middle part of the Ecca series of the typical region of the Karroo The Ecca series is considered to be of Permian age —**Erwin Schuntner** The application of continuous groups to discontinuous linear groups —**Constant Lurquin** The criteria of probability in the sense of Bienaymé Tchebycheff

Aug 3 —**Raymond Defay** Introduction to the thermodynamics of open systems —**Erwin Schuntner** The application of continuous groups to discontinuous linear groups (2) —**Lucien Godeaux** Remarks on the envelope of the Lie quadrics of a surface —**P E Bourgeois and J F Cox** Contribution to the research on the cause of the non-uniform distribution of the longitudes of the peristars of the spectroscopic double stars

Rome

Royal National Academy of the Lincei Communications received during the vacation, 1929 —**O M Corbino** Functioning of the triode with strong magnetic coupling with an iron nucleus between plate circuit and grid circuit —**A Angeli and Zvi Jolles** Certain oxidation processes determined by normal diazo hydrates It was shown recently that, under the action of stannous hydroxide, normal diazobenzene hydrate loses its oxygen atom to give rise to a highly labile product, C_6H_5 N NH, which afterwards under goes a series of transformations, one of these resulting in the formation of benzene This oxidising action of diazobenzene hydrate has now been demonstrated with ferrous hydroxide, hydrogen peroxide, hydroxylamine, potassium ferrocyanide, and ammonium sulphide —**B Longo and C Paderi** The biological significance of alkaloids on plants Experiment shows that alkaloids act, both on seeds and on plants containing them, as true excitants The exciting action is specific in the case of plants, but not with seeds —**B de Finetti** The possibility of exceptional values for a law of aleatory increments —**G Colonnetti** Alterations in the elastic condition of a mortised arch effected by addition of a chain —**B Finzi** Observations on the regular motion of viscous liquids —**F Lamberti** The component elementary motions of the relative baricentric motion of a material system —**E Raimondi** Dynamic effect of a translatory current investing a thin cylinder in the neighbourhood of an independent plane wall —**M Merola** Study of the variable SX Herculis A series of 82 photometric observations made on this star at Capodimonte between Aug 27, 1927, and Dec 1, 1928, allow of the determination of two maxima and two minima, thus confirming the irregularity of the period and of the light curve noticed by other observers —**S Aurino** The photometric system of Naples Comparison of the Draper Catalogue with the Astrographic Catalogue of Catania reveals the existence of a systematic error in the Draper Catalogue function of stellar magnitude The photometric system of Naples appears to be in excellent agreement with Miss Leavitt's system of photographic photometry (Harvard) —**C Cannata** The ballistic hypothesis and the verification of the law of areas in the orbits of telescopic stars Results are given which show that, for the orbits of telescopic stars, the perturbations induced by the ballistic hypothesis are generally insignificant Moreover, with rare double stars in which such perturbations appear relatively conspicuous, these are always within the limits of observational errors For orbits of slight eccentricity, the perturbations leave undisturbed the obedience to Kepler's second law —**E Persico and F Scandone** The Hall effect with extended electrodes (2) —**M Lelli** W Thomson's minimum heat theorem Comparison is made between the Joule heat evolved in unit time by a conductor traversed by a current and that evolved when, not the current intensity, but the values of the potential (supposed everywhere continuous) at the electrodes are fixed, and when also at every point Ohm's law of movement but not that of continuity of current is satisfied This is equivalent to comparing the effective stationary regime naturally established in the conductor with others provoked by keeping the terminal potentials unchanged by immission in certain zones and emission in others The result shows that, in the former case, the Joule heat generated is at a minimum, an extension

of Thomson's minimum heat theorem being thus deduced The corresponding theorem of electrostatics is capable of analogous extension —F de Carli Viscosity isotherms of binary mixtures (5) The system nitrobenzene stannic bromide Thermal analysis of this system does not reveal the formation of a compound between the components, but investigation of the viscosity-composition relationship demonstrates the existence of an additive compound, probably $2C_6H_5 NO_2, SnBr_4$, stable in the liquid state —Giambattista Dal Piaz Geological data on the regions of the Aurine Alps and of the Giant Vedrettes (Upper Adige) (2) —G Brunelli The skeleton of teleostians studied by means of radiography, in relation to the mechanics of movement —U Cassinis and L Bracaloni Normal and alimentary alcoholhæmia during physical exercise (2)

Official Publications Received

BRITISH

The Quarterly Journal of the Geological Society Vol 85, Part 4, No. 340 December 31st, 1929 Pp 389 689 + plates 23 47 (London Longmans Green and Co, Ltd) 7s 6d

River Flow Records Ness Basin River Garry (Inverness shire) Report on River Flow, July to September 1929 By W N McClean. Pp 4+8 tables (London River Flow Records) 1s 6d

World's Poultry Congress Crystal Palace, London, 22nd to 30th July 1930 The Post-Congress Tour 31st July to 11th Aug 1930 Pp 24 (London Ministry of Agriculture)

Proceedings of the Cambridge Philosophical Society Vol 26 Part 1, January Pp. 121 (Cambridge At the University Press) 7s 6d net

Air Ministry Aeronautical Research Committee Reports and Memoranda. No 1266 (E 34) Experiments on Flame Extinction in Gaseous Mixtures. By Squadron Leader W Helmore Work performed for the Aeronautical Research Committee at the Cambridge University Engineering Laboratory (I C E 680, revised) Pp. 17+4 plates (London H M Stationery Office) 1s net

Pharmaceutical Society of Great Britain Pharmacological Laboratories Fourth Annual Report 1929 Pp 16 (London)

Worcestershire County Council Agricultural Education Sub-Committee Ox Warble Fly Report on the Demonstration and Experiments carried out in Worcestershire in 1928 and 1929 Pp 26 (Worcester)

Liverpool Observatory and Tidal Institute Annual Report, 1929 Pp 15 (Liverpool)

Gold Coast Survey Department Professional Paper No 1 Notes on the Application of the Method of Least Squares to the Adjustment of Triangulation and Level and Traverse Networks By J Clendinning and F Yates Pp iii+81 (Accra Government Printing Office) 10s

Transactions and Proceedings of the New Zealand Institute Vol 60 Part 3, September 1929 Pp iv+379 520+plates 33 59 (Wellington, N Z)

Hull Museum Publications No 161 Meaux Abbey By T Sheppard Pp 32 No. 162 Catalogue of the Mortimer Collection of Prehistoric Remains from East Yorkshire Barrows By T Sheppard Pp viii+146 1s No 163 Hull Museum Treasures By T Sheppard Pp 32 No 164 Cissbury Evolution of Furniture Lincolnshire Worthies By T Sheppard Pp 22 No 165 Catalogue of the Fewster Collection of F S Smith's Sketches of Old Hull By T Sheppard Pp x+82 No 166 The Position a Museum should hold in the Life of a Community? by Sir Frederic G Kenyon The Mortimer Collection of East Yorkshire Antiquities, by T Sheppard Pp 10 (Hull)

Proceedings of the Geologists Association Edited by A K Wells Vol 40, Part 4 January 31st. Pp 307 394+plates 27-32 (London Edward Stanford, Ltd) 5s

Journal of the Chemical Society January Pp iii+185+xvi (London)

Department of Scientific and Industrial Research Report for the Year 1928-29 (Cmd 3471) Pp v+200 (London H M Stationery Office) 3s 6d net

FOREIGN

United States Department of Agriculture Weather Bureau Monthly Weather Review Supplement No 32 Climatological Data for Southern South America. By W W Reed (W B No 995) Pp ii+96 (Washington D C Government Printing Office) 10 cents

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol 81 A Further Collection of Birds from Siam By Rodolphe Meyer de Schauensee Pp 523 588 Notes on Japanese and Chinese Fishes By Henry W Fowler Pp. 589-616 (Philadelphia.)

Proceedings of the United States National Museum Vol 79, Art 18 Two New Mollusks of the Genera Ostrea and Exogyra from the Austin Chalk, Texas By Lloyd W Stephenson (No. 2815) Pp. 6+8 plates. (Washington, D C Government Printing Office)

Publikace Pražské Státní Hvězdárny Čís 5 The Spectral Distribution of Stars, magnitude 7 0 and brighter, in the Henry Draper Catalogue By Dr Otto Seydl. Part 1 Text and Tables. Pp 54 Part 2 Maps Pp. ii+14 maps (Prague.)

Bulletin of the American Museum of Natural History Vol 59 Art 2 The Pennsylvanian Tetrapods of Linton, Ohio. By Alfred S Romer Pp. 77 147 (New York City)

United States Department of Commerce Coast and Geodetic Survey Serial No 455 Results of Magnetic Observations made by the United States Coast and Geodetic Survey in 1928. By Daniel L Hazard Pp ii+85 (Washington, D C Government Printing Office) 10 cents

The University of Colorado Studies. Vol 17, No 3 Abstracts of Theses for Higher Degrees in the Graduate School, 1929 (University of Colorado Bulletin Vol 29, No. 14 General Series No 275) Pp 193-268 (Boulder, Colo) 1 dollar

Unione Astronomica Internazionale Immagini spettroscopiche del bordo solare osservate a Catania, Madrid, Zö Sè e Zurigo negli anni 1925 e 1926 Pubblicate per cura del R. Osservatorio Astrofisico di Arcetri Pp 11+19 tavole (Firenze)

Pubblicazioni della R. Università degli Studi di Firenze Fascicolo N 46 Osservazioni e Memorie del R Osservatorio Astrofisico di Arcetri Pp 98+2 tavole (Firenze)

CATALOGUES

X Ray Couches Screening Stands Tube Stands etc Pp 24 (London Watson and Sons (Electro-Medical) Ltd)

The Sunic Surgical Diathermy Apparatus Pp 4 (London Watson and Sons (Electro Medical) Ltd)

English Colour Plate Books of the Nineteenth Century a Catalogue of Books of Sport Travel and Humour (New Series No 5) Pp 32+7 plates (London Francis Edwards Ltd)

Diary of Societies

FRIDAY FEBRUARY 28

ELECTRICAL ASSOCIATION FOR WOMEN (at 46 Kensington Court), at 3 — L I Robinson Tariffs

PHYSICAL SOCIETY (at Imperial College of Science), at 5 —C H N Lock The Equations of Motion of a Viscous Fluid in Tensor Notation —W L Watton A New Type of Dewar Flask for Use as a Calorimeter —R O Cherry Field Intensity Measurements around some Australian Broadcasting Stations

ROYAL SOCIETY OF MEDICINE (Disease in Children Section) at 5 30

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7 30 —J Rowcroft The Design of Dynamos for Automobiles

ROYAL SOCIETY OF MEDICINE (Epidemiology Section) at 8 —Sir Leonard Rogers Further Experience in Forecasting Epidemics in India and their Bearing on the Reduction of Cholera Epidemics

ROYAL INSTITUTION OF GREAT BRITAIN at 9 —Prof G I Taylor A Tour in the East Indies

INSTITUTION OF ELECTRICAL ENGINEERS (West Wales—Swansea—Sub-Centre).—I C Grant The Breaking Performance of High Power Switch gear and of a New Form of Quenched Arc Switch

SATURDAY MARCH 1

GEOLOGISTS ASSOCIATION (at Museum of Practical Geology Jermyn Street) at 2 30 —C P Chatwin Demonstration of The Palæontology of the Reigate Sheet

ROYAL INSTITUTION OF GREAT BRITAIN at 3 —W Rothenstein Nineteenth Century Painting in France and England (2)

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College) at 5 —Prof W M Roberts Energy and some Points in Statics

GILBERT WHITE FELLOWSHIP (at Queen Square, W C 1), at 8 —Conversazione and Exhibition

MONDAY, MARCH 3

ROYAL SOCIETY, EDINBURGH at 4 30 —W N McClean River Flows of the Ness Basin —Gertrude Lilian Elles and C E Tilley Metamorphism in Relation to Structure in the Scottish Highlands

VICTORIA INSTITUTE (at Central Buildings Westminster), at 4.30 —Lieut Col T C Skinner The Significance of the Old Testament Scriptures to our Lord Jesus Christ.

ROYAL COLLEGE OF SURGEONS OF ENGLAND at 5 —C E Shattock Demonstration of Affections of Lymphatic Glands

SOCIETY OF ENGINEERS (at Geological Society), at 6 —J Pickin Machine Tools followed by a Film entitled A British Key Industry

ROYAL INSTITUTION OF GREAT BRITAIN at 6 —General Meeting

INSTITUTION OF AUTOMOBILE ENGINEERS (Bristol Centre) (at Merchant Venturers Technical College, Bristol), at 7 —H R Ricardo Combustion in Diesel Engines

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting) at 7 —J J Fisher and others Discussion on Push Button Control

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University) at 7 —Lt Col S E Monkhouse and I C Grant The Heating of Buildings Electrically by means of Thermal Storage

INSTITUTION OF MECHANICAL ENGINEERS (Graduates Section—London) (Annual Meeting) at 7 —Informal Discussion on Workshop Practice at Home and Abroad

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8 —F Pick The Design of Modern Railway Stations in Europe and America

ROYAL SOCIETY OF ARTS, at 8 —A B Searle Recent Improvements in Methods of Brickmaking (Cantor Lectures) (3)

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8 —Dr C Ainsworth Mitchell Circumstantial Evidence from Fibres and Hairs —H M Langton The Splitting of Castor Oil

TWICKENHAM LITERARY AND SCIENTIFIC SOCIETY (at Free Library, Twickenham), at 8 —Rev Dr J J Doyle Some Aspects of Higher Education in the United States

INSTITUTION OF THE RUBBER INDUSTRY (London and District Section) (at Engineers Club Coventry Street) —Dr H A Daynes Methods and Appliances used for the Control of some Manufacturing Processes in the Rubber Industry

TUESDAY, MARCH 4

ROYAL SOCIETY OF ARTS (Indian Section), at 4 30 —T M Ainscough British Trade with India

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5 —Dr J A Glover The Incidence of Rheumatic Diseases (Milroy Lectures) (1).

Royal Institution of Great Britain, at 5 15 —Sir William Bragg X ray Determination of the Structure of Cellulose and Similar Substances (4).
Zoological Society of London, at 5.30.—A. B Martynov On the Trichopterous Fauna of China and Eastern Tibet.—Dr R. E. Drake Brockman A Review of the Antelopes of the Genera *Madoqua* and *Rhynchotragus* —M Burton Norwegian Sponges from the Norman Collection.—Dr Marie V Lebour The Larval Stages of *Caridion* (Crustacea) with a Description of a New Species —H W Kew On the Spermatophores of the Pseudoscorpions *Chthonius* and *Obisium* —W S Bristowe A Supplementary Note on the Mating Habits of Spiders
Institution of Electrical Engineers (North Western Centre) (at Engineers Club, Manchester), at 7 —E H Smythe and E G Weeks Low Temperature Carbonisation of Fuel, with Special Reference to its Combination with the Production of Electricity
Royal Photographic Society of Great Britain, at 7 —R. N Speaight Some Interesting Personalities in Photography
Institution of Automobile Engineers (at Royal Society of Arts), at 7 45 —H R Ricardo Combustion in Diesel Engines
Royal Society of Medicine (Orthopædics Section), at 8 30 —S A S. Malkin and others Discussion on Spasmodic Flat Foot.
Institution of Electrical Engineers (East Midland Sub Centre) —J J Denton Television—Progress and Applications

WEDNESDAY, March 5

Institution of Electrical Engineers (Wireless Section), at 6 —H J Lucas Some Developments of the Piezo Electric Crystal as a Frequency Standard —J E P Vigoureux The Valve Maintained Quartz Oscillator
Institution of Heating and Ventilating Engineers (at 29 Hart Street, W C 1) at 7 —Discussion on The Space Required for Central Station Equipment
Institution of Electrical Engineers (Tees side Sub Centre) (at Cleveland Technical Institute Middlesbrough), at 7 15 —B A Robinson Address.
Society of Public Analysts and other Analytical Chemists (at Chemical Society), at 8 —Dr S Judd Lewis (a) The Spectroscopic Investigation of Jams and the like (b) A Simple Polarimetric Test for Sugars in Jams (c) A New Kjeldahl Distillation Apparatus —Prof M S Eldin Bey The Detection and Identification of Alkaloids in the Saliva and Salivary Glands
Royal Society of Arts at 8 —Prof A R Ling Brewing as a Branch of Science
Institution of Chemical Engineers (at Geological Society), at 8.—Prof W E Gibbs The Formation and Growth of Crystals
Royal Society of Medicine (Surgery Section) at 8.30.—Pathological Evening
Royal Microscopical Society (Biological Section)

THURSDAY March 6

Royal Society at 4 30 —*Papers probably to be read* —W J Elford Structure in very Permeable Collodion Gel Films and its Significance in Filtration Problems.—T W Wormell Vertical Electric Currents below Thunderstorms and Showers —Dr N K Adam The Structure of Surface Films
Linnean Society of London, at 5 —Dr S. M Manton Notes on the Segmental Excretory Organs of Crustacea. V On the Maxillary Glands of the Syncarida —Prof G E Nicholls Addendum to his paper on *Micraspides.*—Major R W G Hingston In the Canopy of the Forest—British Guiana
Royal College of Physicians of London, at 5 —Dr J A Glover The Incidence of Rheumatic Diseases (Milroy Lectures) (2).
Royal Institution of Great Britain, at 5 15 —J B S Haldane Some Problems of Genetics
Royal Aeronautical Society (at Royal Society of Arts), at 6 30 —Major F M Green and H C H Townend Resistance of Air cooled Engines
Society of Chemical Industry (Birmingham and Midland Section) (at Birmingham University), at 6 30
Royal Photographic Society of Great Britain (Kinematograph Group —Annual General Meeting) at 7
Society of Chemical Industry (Bristol Section) (jointly with Institute of Fuel) (at Bristol University), at 7 30 —Dr F S. Sinnatt The Cleaning of Coal
Chemical Society, at 8 —G W Fenton and Prof C K Ingold Influence of Poles and Polar Linkings on the Course Pursued by Elimination Reactions Part VII A Generalised Form of the Olefinic Degradation of Sulphones —Prof C K Ingold and J A Jessop (a) Influence of Poles and Polar Linkings on the Course Pursued by Elimination Reactions. Part VIII. The Methylenic and Paraffinic Degradations of Sulphones (b) Part IX Isolation of Substance Believed to Contain a Semi polar Double Linking with Participating Carbon
Philological Society (at University College), at 8 —N B Jopson Work of the London Board of Comparative Philology

FRIDAY, March 7

Royal College of Surgeons of England, at 3 45 —T B Layton Demonstration of The Rhinological Anatomy of the Naso frontal Duct and the Hiatus Semilunaris
Royal Society of Arts (Indian Meeting) at 4 30
Royal Astronomical Society (Geophysical Discussion), at 4 30 —The History of Mountains Opener Dr Harold Jeffreys
Institution of Mechanical Engineers, at 6 —L W Schuster The Strength and Design of Fusion Welds for Unfired Pressure Vessels.
Society of Chemical Industry (Manchester Section) (at Engineers Club Manchester), at 7 —Dr F L Pyman Fine Chemicals
Institution of Electrical Engineers (Meter and Instrument Section), at 7 —A E Moore and W T Slater An Investigation of the Frequency Variations in Induction Watt-hour Meters
Royal Photographic Society of Great Britain (Pictorial Group—Annual General Meeting), at 7
North East Coast Institution of Engineers and Shipbuilders (informal Meeting) (at Bolbec Hall, Newcastle upon Tyne), at 7 15.—W D Horsley and others Discussion on The Effect of the Use of Electricity in Workshops on Efficiency and Costs.
Junior Institution of Engineers, at 7 30 —Lt. Col. G J Hartley Chile and Engineering in Chile
Institute of Metals (London Local Section) (at 83 Pall Mall), at 7 30 —A. Coad Pryor The Manufacture of Glass and some of its more Interesting Properties
Geologists Association (at University College), at 7 30 —Dr A. E Trueman The Lower Lias (Bucklandi Zone) of Nash Point Glamorgan —A A. Fitch The Geology of Etchingham and Robertsbridge, Sussex —G S Sweeting The Geological Structure of the Ashburnham, Battle and Crowhurst Districts, Sussex, with Notes on the Wealden Iron Ore
Royal Society of Medicine (Anæsthetics Section), at 8 30 —Dr C Donald Spinal Analgesia with Spinocain.—Dr H Jones Percain 'Ciba a New Regional and Spinal Analgesic with Special Reference to High Thoracic Nerve root (Splanchnic) Block
Royal Institution of Great Britain, at 9 —Dr C Tate Regan Angler Fishes
Society of Chemical Industry (Chemical Engineering Group) (jointly with Glasgow Section) (at Institution of Engineers and Shipbuilders Glasgow) —J S F Gard and R F Robinson The Insulation of Heated and Cooled Surfaces
Oxford University Junior Scientific Club —Prof C E Inglis The Construction of a Great Suspension Bridge

SATURDAY, March 8

Royal Institution of Great Britain at 3 —Sir Ernest Rutherford Atomic Nuclei and their Structure (1).

PUBLIC LECTURES

FRIDAY, February 28

Imperial College of Science and Technology (Department of Mathematics), at 5 30 —Prof C Størmer The Mathematical Theory of the Polar Aurora (Succeeding Lectures on Mar 5 and 7)
University College, at 5 30 —Prof E Gilson L Idée de Dieu dans la Philosophie de Descartes (Succeeding Lecture on Mar 3)

SATURDAY, March 1

Horniman Museum (Forest Hill), at 3 30 —Dr W G Ivens The Solomon Islands and their People

MONDAY, March 3

Medical Society of London, at 5 15 —Mrs Stella Churchill Infant Welfare Schemes (Chadwick Lecture)
Birkbeck College, at 5 30 —Prof Beresford Pite An Isometric Diagram of the Construction of the Dome of St. Paul s Cathedral Drawn by R B Brook Greaves

TUESDAY, March 4

University College, at 5 30 —Prof J de Vries Early Teutonic Civilisation (Succeeding Lectures on Mar 7 and 11)
Birkbeck College Chemical Society at 6 —Prof A McKenzie The Migration of Hydrocarbon Radicles in Optically Active Compounds

WEDNESDAY, March 5

King's College, at 5 30 —Prof P N Milyukof The Past and Present in Russian History
London School of Economics at 6 —Dr G H Miles The Problem of Incentives in Industry (Succeeding Lectures on Mar 12 and 19)
Belfast Museum at 8 —W R. Gordon The Progress of Modern Painting

THURSDAY, March 6

University College, at 5 15 —Prof O Meyerhof Chemistry of Muscle in relation to Problems of Cellular Physiology (Succeeding Lectures on Mar 7 10 and 12)
Imperial College of Science and Technology at 5 30 —Dr W F Bewley Diseases of Glasshouse Plants (Succeeding Lectures on Mar 13 and 20)
University of Birmingham —Sir William B Hardy The Physical Basis of Life (Huxley Lecture).

SATURDAY, March 8

Horniman Museum (Forest Hill), at 3 30 —Prof J R Ainsworth Davis Casting Life in New Moulds

CONFERENCE.

February 28 and March 1

Association of Technical Institutions (at Skinners Hall, Dowgate Hill, E C 4).
Friday February 28, at 10 30 A M —Lord Eustace Percy Presidential Address
C R Keene The Relationship between the Teaching of Art and Technology
Friday February 28 (*afternoon*), and *Saturday, March* 1 (*morning*).—F W Goodenough The Teaching of Salesmanship in Technical Colleges
G H Gater A Descriptive Account of Technical Education in London
E. Salter Davies, Sir Percy Jackson, and Principal J H Everett The Raising of the School Leaving Age and its Effect upon Technical Education
Principal R S. Clay and others Discussion on Technical Education for the Plumbing Trade, with Special Reference to the Rural Apprentice.

SATURDAY, MARCH 8, 1930

CONTENTS.

School Science and Educational Values.

WHETHER one agrees with Prof H E Armstrong or not—and frequently one does not—there is always to be found in his utterances much that is arresting, and in his writings much that stimulates One is often grateful to him for saying things which one is glad should be said—by someone else Even when his characteristic, pyrotechnic methods of expression become familiar, one is forced into the position of an attentive, if critical, student of his views One can enjoy his serious humour, admire his courage, deplore his exaggeration, but one seldom fails to experience the fresh air of common sense and the provocation to renewed thought about fundamental things which he offers to his audience When, in particular, he expresses an opinion on the teaching of science in our schools and universities, it is possible—rather it is profitable—to follow with care his exposition without necessarily finding oneself in complete agreement either with his generalisations or with his proposed remedies This attitude is presumably exactly that which our critic would wish to produce, for the policy of follow my leader is above all distasteful to him, and he would have both teachers and taught think and work out their scientific salvation each for himself

In a recent address to the West Kent Scientific Society, as reported in the *Kentish Mercury*, Prof Armstrong offered a vehement criticism of the type of education provided in both schools and colleges, his title was "Our Present Curse of Education", and his war cry "Down with the outside examiner" Teachers who are wise enough to read his address must expect to receive a 'wigging', and their anticipations will be duly realised They will, nevertheless, be indebted to him for his persistence in stepping on the weak planks in the educational platform, and might even forgive him his failure to commend the general stability of the structure which they have laboured, not unintelligently or unsuccessfully, to erect It is safe to say that Prof Armstrong is not alone in being dissatisfied with methods or with results, the urge to progress is a fairly common experience in educational circles It is equally safe to assert that our *Weltanschauung* has changed more rapidly than our educational technique But when Prof Armstrong asks us to agree that our schools remain happy hunting-grounds for pottering pedagogues, or that the admirable qualities of which the world is in need are the very opposite of those which characterise teachers as a class, or that no subject

is or can be properly taught in girls' schools, he will not be surprised to detect a suspicion of hesitation about our applause Nevertheless, if it is necessary to throw a few bricks in order to concentrate attention on the fact that we are not yet a scientifically equipped nation, that our only chance of happy survival is to make ourselves such, and that our leaders into the future must be scientifically minded men and women, then bricks let there be, and Prof Armstrong throws as devastatingly as any

Scientific or not, however, a nation may reasonably be expected to express itself adequately in its native language, and widespread inability to do so is specially to be deplored among its rising scientific generation English, he says, should be taught at all times and through all subjects of instruction, we can but agree Such incompetence is within the everyday experience of those who have to read science students' essays, and is still frequently noticeable in the reports of original work written by experienced investigators Latin, adds Prof Armstrong, is the only subject that is and can be properly taught to day—apparently because our schools are practically all 'in Latin hands', there are no skilled teachers for the other subjects, and foreign languages, in particular, are not regarded seriously Languages and mathematics, as he truly says, may be taught as definite subjects, the objective is clear, whilst in other class subjects there is no fixed method of approach

It is not entirely obvious whether it is for this reason, or in spite of it, that Prof Armstrong urges that more time should be devoted to the subject of languages, in his conclusion, however, he is probably correct Intercourse between the nations of the world is in a stage to warrant the extension, and mutual goodwill and understanding, whether scientific, commercial, or political, cannot fail to profit thereby Moreover, the taste for languages is a good and useful taste, and good taste should be acquired in early life He would next study geography, not geography as we ourselves were taught, but a living geography including geology, agriculture, etymology, and anthropology When we add the necessary basis of physics and chemistry, not forgetting also biology, we have the group of concrete sciences which, called geography or any thing else, is bound to figure in any intelligent story of man and his home Greater informality in school science there probably should be, but it will become doubly necessary to guard against permitting the book of knowledge to degenerate into a mere album of entertaining snippets Even more probably there should be some broadening of the scientific basis of instruction, particularly in the direction of simple biology This extension here and broadening there will, however, fail in its immediate purpose if it has in view merely an ideal universal code of education, it should be conceived as part of an elastic system adaptable to varying intellectual and material requirements Neither pupils nor teachers are cast alike in the same mould, so that we need not expect, however emphatic or unorthodox our views, to discover a universal solvent for such problems

Wholesale condemnation falls not only on school science as taught to day, but also on external examiners and all their works "If", says Prof Armstrong, "the external examiner is allowed to pursue his fell and cursed commercial purpose much longer, schools throughout the country will be ruined, they will lose all liberty to experiment, all liberty of teaching, and will turn out only automata" It can scarcely be supposed that Prof Armstrong, a scientific man, is attempting to deny the appropriateness of an independent test in helping to determine how a pupil is reacting towards his educational environment, so that it would appear that this is only his playful way of recommending modification in the nature of the tests to be applied, and in the circumstances of their application

In any event, the vocational significance of such educational tests is a matter to be reckoned with nowadays, when most men's brains have to earn their bread, and acceptable tests of some kind of commercial significance there will have to be It is not evident whether the stimulus of independent tests in promoting application to study is equally denied, or whether one is in future to rely on a universal consuming desire to acquire more knowledge and to acquire it in a logical way, on an irresistible impulse in youth to discover and apply scientific method The heuristic procedure is admittedly a potentially effective instrument in the skilled teacher's hands, and given a suitable medium it is no doubt capable of highly successful application The inquisitiveness of the scholar, constantly directed in logical channels by a sympathetic and provocative teacher, can be turned to good account in setting in motion the wheels of the mind, but even a well oiled engine requires fuel, as an agile mind requires a generous knowledge of fact That is not to say that fact is more important than method, it is to say that instruction has its proper and fundamental place in education Early specialisation is, of course, to be avoided, and a pass degree may have merits

unshared with an honours degree where the dis semination of knowledge rather than its acquisition is in question Specialists are frequently heard to complain of the narrow outlook which the present stage of development of science has forced them to maintain in the pursuit of their objective Is not therefore the danger in loosening external control of progress accentuated rather than reduced ? It might reasonably be argued that the heuristic method of all methods requires the watchful eye of an outside examiner, albeit a wise and sym pathetic one It is the very narrowness of school science of which Prof Armstrong complains

It is, indeed, even an open question whether research, by members of the teaching staffs of our universities, is not being exalted above its proper place in the scheme of things , whether the student is not being subordinated to the published paper , whether the teaching function, with its concomit ant requirement of leisure for thought and reading, should not receive greater attention and recognition This is a matter which has recently been discussed by the president of the Association of University Teachers, who views the present tendency with some concern The question, however, bears only in directly on our subject , another consideration has a more direct influence It appears impossible under existing conditions to remove Prof Arm strong's engaging and important problem from the domain of theory to that of practice, for the essence of the method is greater informality, elasticity, and individuality than is usually possible in a school or graduate college class of the usual size and hetero geneity Large classes, or even classes less large, are scarcely amenable to real heuristics, and failing the substance the shadow is probably of negligible value in comparison with the conventional article

A A E

Britain's Coal Resources

PROF J H JONES gives a very complete and useful summary of the existing conditions of the coal industry of Great Britain in a paper entitled "The Present Position of the British Coal Trade" in the *Journal of the Royal Statistical Society*, Vol 93, Part 1, 1930 He has collected valuable statistics from British and foreign sources and has published these in some twenty nine tables by way of an appendix to his paper , these figures form also the basis of the paper

Prof Jones has dealt with these statistics in the effective manner that might be expected from so accomplished a statistician Any defects in his treatment of the subject are due to the fact that he is a statistician and not a miner, and, therefore, overlooks some of the points which to a mining engineer would have been comparatively obvious Thus he deals in considerable detail with the falling off in British output, which he determines by a comparison of the present condition with conditions in 1913, the last pre War year He apparently overlooks the fact that 1913 was an exceptionally prosperous year for the coal trade, and should not be used as a basis for comparison

In any case, however, the fact that the British coal trade has fallen off compared to what it was in the years immediately preceding the War cannot be disputed Prof Jones does not, however, ap pear to see, as a mining engineer would, that this falling off is an inevitable consequence of the lead which Britain enjoyed for so long among coal producing nations He has overlooked the fact that coal, like every other mineral deposit, is a wasting asset, and that the nation which, like Britain, first developed and worked its richest seams, thus supplying the markets of the world, must inevitably sooner or later come to the stage when, with incipient exhaustion of these exception ally fine and accessible seams, other nations are able to enter into competition with it on more equal terms

The conclusion that Prof Jones reaches is as follows "The machinery which is now being established serves merely to relieve the pressure of excessive competition The cause can only be removed by a reduction in the producing capacity of the industry to the volume of demand which is likely to exist under the new conditions, I believe that we may reasonably expect the industry not only to recover some of its lost markets on the Continent, but also to benefit from a growing demand for home consumption"

As a statistician, Prof Jones is perhaps justified in his conclusion from a study of the statistics of the industry, but it is scarcely one that can be justified in the eyes of those who know all the circumstances of the case

Even a statistician might, however, find grounds for apprehension, seeing that Britain's probable coal resources are only about 3 per cent of the probable resources of the world, whilst Britain's coal output, as Prof Jones shows, is approximately one fifth of that of the whole world and fifty years ago was practically forty four per cent These figures surely indicate that Great Britain could not possibly maintain its leading position at the above rate of output for more than a limited period

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature *No notice is taken of anonymous communications*]

Organic Chemistry in Peril

The *Times* of Feb 21 contains a remarkable article by Prof George Forbes, in which he describes his experience in 1877 when endeavouring to act as war correspondent in the Russo-Turkish war He was foiled by the Russian officials in every attempt that he made to join their army, until he met with a Prince Swiatipolk Mirski—a distinguished supporter of literature and the arts, well known in Parisian society—who was in charge of Transcaucasia After they had talked together for some time, the Prince suddenly asked him "Are you any relation of the late Principal James David Forbes?" When Forbes replied that he was his son, the Prince grasped him by the hand—'was very pleased to meet him', he had so much admired his father's discoveries in relation to glaciers and other branches of science—and roared with laughter as he remarked "And to think that they looked upon you as a Turkish spy" (I wonder if the prince did begin his sentence with that conjunction?) From that moment Forbes's difficulties disappeared he soon received a permit and was free to go under fire, he did so right valiantly "Thus, as constantly in my life," writes Forbes, "I was given the chance to do greater things than my own merit deserved, through the esteem, veneration and affection in which that great man, my father, was held" A more moving expression of filial reverence, of justified ancestor worship, has not been penned

All this by way of showing that it pays to have a father and have him remembered In London, we are in danger of forgetting our fathers, especially the fathers of organic chemistry and of disregarding their work—of showing ourselves unable to appreciate its value and the supreme importance of carrying it on, with ever increasing intensity of effort Two most weighty letters were printed in Nature of Feb 15 from Sir William Pope of Cambridge and Prof Jocelyn Thorpe of the Royal College of Science, London, both protesting against the proposed substitution of physical chemistry for organic chemistry, when Prof Robinson leaves University College, London, to succeed the late Prof W H Perkin, jun, at Oxford I agree with every word they say To adopt the policy that is advocated will not be merely suicidal but criminal, at a time when the two great organic chemical industries of dyestuffs and pharmaceuticals are beginning at last to flourish here It involves going back upon every argument we have used, during and since the War, in support of the promotion of chemistry as the backbone of manufacturing industry Take the extreme case of the production of ammonia from atmospheric nitrogen—this is sometimes spoken of as if it were an achievement of physical chemists in fact, it is almost entirely a capitalistic and engineering triumph, there is very little chemistry in it that is in any way special Whatever it be, it is useless as a practical enterprise without organic chemistry Anyone, given the capital, can now make ammonia the difficulty is to sell it with advantage The whole commercial future of nitrogenous fertilisers is a problem of the very highest organic chemistry—of agricultural and physiological chemistry As a matter of fact, the nitrogen industry, at present, is working in physical chemical blinkers, it has put itself far too much under the guidance of men without vision

We need to go back to the 'forties to read what was said by the late Lord Playfair—one of the very few broad minded scientific men who have advised Great Britain, one of the chief founders of our system of scientific technical education In the Hofmann Memorial Lecture (Chemical Society, 1893), he tells how the illustrious Liebig, in 1841, published his celebrated work—"Chemistry of Agriculture and Physiology"—and of its magic effect Personally conducted by Playfair, he toured England in 1842, with the immediate effect of making chemistry a popular science The School of Mines was opened in Jermyn Street, University and King's Colleges began to give attention to laboratory teaching, then in 1845 came the Royal College of Chemistry, with Hofmann at its head, next to Liebig the greatest organic chemist—taking the times into consideration—the world has known

Such is the debt of chemistry to agriculture—it were time that it returned the compliment and gave competent chemists to agriculture—competent organic chemists but also sons of the soil, with full understanding of living things Even physical chemistry to day, great as has been its vogue, is neither physics nor chemistry, its business is but to point the bricks of the great structure laid by the chemist's trowel, chiefly the organic chemist's We have not a competent agricultural chemist to day (there has not been one since Liebig), we have not a competent physiological chemist, that is to say, one sufficiently gifted with the divine afflatus of chemical science and also a 'physiologist' To arrive at full understanding of the right ways of feeding the soil, the plant, the animal—ourselves included—we must be chemists, especially on the organic side

I have long foreseen the danger In an article which I wrote for the *Manchester Guardian* (special Levinstein number), during the War, I contended that, if Manchester wished to give chemistry a recognised position consonant with its industrial importance, a special chair should be endowed in the University to which a stipend of at least £5000 should be attached It mattered not whether anyone were worth so much at the moment demand would create supply Chemistry is dead in Manchester to day and not fully alive elsewhere—yet Manchester is the metropolis of the great organic textile industry Only one organic chemist of high degree is left to us now that we have lost Perkin Something we must do, to counter the selfish action of industry—this, too, in the ultimate interest of industry We hear of commercial magnates with salaries up to £30,000 No commercial magnate can have the same ultimate value as a real organic chemist

Claiming, as I can, Hofmann as my spiritual father, I am able to look back sixty five years across the field of chemistry and, in some measure, evaluate the progress made in its several sections Progress there has been—great general progress—but the mathematical physical section has been too much pampered It has even brought the wrong type of mind—the accountants'—unduly to the fore Chemistry, after all, is a science of deeds, things have to be made, not merely talked about hypothetically and weakly measured—it is largely an affair of fingers and an art The organic chemist, in particular, is highly imaginative but his imagination rests upon an entirely sane background X rays are but serving to justify his highest flights of imagination—going no further

We are not really getting down to the big problems We have to view with concern the slowness with which our attack upon the carbohydrates matures Little more is *settled* of the nature of starch than was established by O'Sullivan and Horace Brown in my early days We have not yet *decided* even the con texture of the glucoses Beilstein, the record of organic chemistry, already has 12 large ordinary and 3 supplementary volumes and will not be completed in less than ten more It already costs £60 Only real men can teach a subject of such magnitude

To serve the ends of the British Empire, we have to strain every nerve to secure more competent chemists of all kinds—no delay is permissible At the moment, industry here and, particularly, in America is thwarting academic efforts to produce them, by tempting men of potential ability prematurely into industry, before their intelligence is sufficiently ripened by confining their labours, it is tending to promote intellectual sterility, parents so trained cannot have healthy offspring

University College, in virtue of its Medical School, is marked out as the great biological centre of the future That future will be indefinitely postponed, unless the College maintain a highly developed, complete Department of Organic Chemistry—pure and applied To think that a few calculating machines will suffice us in producing a great work of art is obviously absurd

Prof Forbes was helped by a single father I can claim the support of several—of an entire organic ancestry Hofmann put me to work under Frankland and Frankland sent me on to Kolbe three lineal descendants of Liebig Returning, I was adopted by Williamson of University College and became the first Perkin's colleague Being of such organic parent age, I may claim to speak with some authority I would urge that it is impossible to think of the service Williamson rendered to organic chemistry, by resolving the chaos surrounding alcohol and ether then, in the College where he taught, to do the great wrong to organic science that is now threatened It cannot be! It must not be!

HENRY E ARMSTRONG

The Scientific Principle of Uncertainty

'IF the actual history of science had been different, and if the scientific doctrines most familiar to us had been those which must be expressed in this [statisti cal] way, it is possible that we might have considered the existence of a certain kind of contingency as self evident truth, and treated the doctrine of philo sophical necessity as a mere sophism "

This is not a quotation from an exposition of the quantal doctrine of the essential uncertainty of physical knowledge, which recently startled the philo sophical world It is taken from the inaugural lecture at Cambridge in 1872 by Clerk Maxwell, the creator, in conjunction with Boltzmann, of the science of dynamical statistics, the development of which gave promise of rapid progress about that time

The essence of the matter is that in this subject, as it gradually emerged in close connexion with gas theory, the primary feature was the invariant specification of the differential receptacles or cells for the statistics, propounded as an analytical result by Liouville in his *Journal*, vol 3, pp 342 9 (1838), and rediscovered to some purpose by the redoubtable pair, Maxwell and Boltzmann, about 1876 They were stimulated to the broadening of the subject by introduction of general ised co ordinates in the modern manner, by the physical vitalising of the Hamiltonian revolution in dynamics of date 1834, by Thomson and Tait in their "Natural Philosophy" in 1868 This re statement in generalised form appears to have been first exhibited in H W Watson's tract on gas theory in 1876, written with access to Maxwell's private notes pub lished in his memoir of 1879, and its lucidity was re marked on by Boltzmann The essential point was that in the specification of these invariant cells, a range of any co ordinate δq occurred multiplied by a range of the cognate momentum δp, and that the factors of this product could not be separated, so that any refinement of exactness in one variable involved a loosening in the other

JOSEPH LARMOR

Cambridge, Feb 14

Unemployment and Hope

IT is certainly a hopeful sign to find in NATURE of Feb 15, p 225, the interesting article under this heading by Mr W G Linn Cass, ending with the plea that originality and freshness of view in this old question were never in the history of the world more or more urgently needed than now I trust it may not fall on deaf ears, for in my experience, hitherto, scientific men have shown themselves in this question perhaps rather more bigoted and intolerant than can be wholly accounted for by their natural conservatism Possibly it is a suppressed consciousness of guilt, for, after all, unemployment or leisure, two ways of stating essentially the same condition, is the most natural as it is the inevitable consequence of their achieve ments

In any conceivable economic system, labour saving is the unquestioned goal of the application of science to industry, but few dare to see the process through to its absurd end under the present system As science multiplies by n the productability of labour, $(n-1)/n$ lose their livelihood and with it their title to consume, so that, but for the 'dole' and similar confiscatory legislation, consumption would be re duced to $1/n$ No more stupid or criminal waste of creative effort surely could be imagined

It may be comforting, but it is certainly very short sighted to argue that it will all come right of itself in the end, because scientific invention and discovery create more work than they displace Admittedly, at first the $(n-1)$ surplus goes to feed the $(n-1)$ dis placed men who are put to create new productive enterprises When these, in turn, produce, the original deadlock returns in exaggerated form In this respect New Testament economics was clearer than that taught in modern universities, since it distinguished the cate gory of the wealth which perishes from its negative form, debt, which accumulates at interest Unem ployment, or leisure, should be the avowed object, as it is the inevitable consequence of scientific produc tion

I cannot subscribe so heartily to the Biblical economics, which I suspect has influenced Mr Cass to invert the natural function of industry, and to put production as second to the exercise of faculty and the growth of character The right use of leisure is—Who can doubt it?—one of the dominant prob lems of a scientific civilisation But why should industry be necessarily charged with this alien func tion? It is educational, and should be the care of universities, training schools, theatres, the churches, the Press, and so on The end is surely easier of attainment by leisured people, supported by what science is capable of supplying without taking their entire lives for it, than as a means of livelihood in competition with scientific methods Much as on lookers may deplore the mechanicalisation of industry,

Mr Ford is probably accurate as to the present psychology of the worker in his belief that what they want is to be told what to do, how to do it, and be allowed home in the quickest possible time They prefer, as most of us scientific workers would, leisure to task work, however interestingly it may be disguised

It is also hopeful to note the growth, if slow, of the conclusion reached by all who have recognised that the problem is not one of production but of distribution, that no reform is possible without reform of the money system Mr Cass refers very cautiously to "financial reform in the direction of a measurable amount of inflation, possibly on the lines suggested by Arthur Kitson, Douglas, and others", as a possible way of approach to the unemployment problem The present state of inflated France, reported to be able to find work for a million alien workers, and deflated England with between one and two million workers permanently unemployed, is eloquent of the importance to industry of the distributing mechanism, the money system Both rob Peter to pay Paul, the creditor class in the one case and the taxpayer in the other, bearing the loss

I differ from the reformers cited, while in general agreement with their diagnosis of the industrial and economic situation, in the belief that it is not only possible for a scientific era to devise a stable monetary unit of value, but that it is of far more consequence to its social well being, even than invariable standards of weights and measures To me, the present system, in which the quantity of money in circulation is a function of the extent people are allowed to overdraw their accounts and spend what no one knowingly has given up, is mere 'account cooking', already responsible for much if not most of the present deadlock To believe that greater laxity in accounting is going to produce anything but more confusion and bitterness is impossible What I think is needed is a much clearer perception of what each expansion of industry involves, the permanent locking up of some definite quantity of wealth in the enlarged flow—not the same wealth but the same quantity permanently—and the necessity of accounting for this quantity just as for capital expenditure in a straightforward manner, without as at present simply drawing upon the general purchasing power of money to meet the outlay Granted this, with the accountancy of the monetary system kept according to the ordinary laws of arithmetic, I do not see any difficulty in maintaining a monetary system with an invariable standard of value and yet capable of distributing all that society is willing and able to produce

FREDERICK SODDY

APPRECIATION by some of our leading men of science of the difficult problems raised by the increasing application of science to industry is to be welcomed, whether it be due to a less suppressed consciousness of guilt or to greater leisure, and the position calls not for less science but more, especially in the sociological sphere rather than in the physical Progress in the social sciences has probably not kept pace with that in the physical, so that there is some uncertainty and bewilderment as to the best and wisest organisation and utilisation of the marvellous wealth and resources placed at our disposal by chemistry, physics, and engineering A greater knowledge and more skilful use of the statistical method in economics and politics as exemplified in Sargant Florence's great work and others, together with more boldness in making social experiments, would greatly accelerate progress in the desired direction Definite measurement and experimentation, and ultimately we shall hope, prediction also, are probably much more possible in the social sciences than is commonly supposed, and can alone justify the appellation of 'scientific' They should replace the vague evolutionary fatalism, by which things will eventually right themselves, and the unsubstantiated hypotheses which still cloud our horizon

Prof Soddy suggests that in one important respect, which appears to be that of relative values, New Testament economics, or the ancient oriental theocracy, is clearer than that taught in modern universities, and if this be so, then one should be the more, rather than the less, disposed to subscribe to the Biblical economics which may have induced me to invert the natural function of industry, making production secondary, for here also we are dealing with the determination of relative values But perhaps this division of the aims of industry into moral or spiritual, on one hand, and material on the other, was not the best or most complete analysis that could be made, and was done chiefly with the view of emphasising one aspect of industrialism that might just possibly be overlooked

It is not easy to agree that unemployment and leisure are essentially two statements of the same condition except by violent distortion of definitions, or that industry should have no responsibility in connexion with the right use of leisure Of course, under modern conditions, industry is not actually "charged with this alien function", but industry certainly largely determines the amount of leisure, and its proper use is by no means a matter of indifference to the prudent and up to-date employer He does not think it advisable entirely to disclaim all responsibility herein, and rely wholly on the theatres, churches, and Press, or even on the universities and schools Even Mr Henry Ford, or perhaps he more than any one else, realises the importance of a right use of leisure, and in proportion as Mr Ford is correct in his view of the relations between man and his work, a rather hopeless view it seems, so much the more important is leisure and its use

W G LINN CASS

An Apparent Rôle for the Thymus (in Calcium Metabolism)

IT has already been reported (Harris and Moore, *Biochem Jour*, **23**, 261 1929) that hypervitaminosis D always involved an atrophy, indeed eventually virtual disappearance, of the thymus, and similar changes in other lymphadenoid tissue—a discovery which has since led us to the observation that an equally remarkable fall occurs in the lymphocyte count in the same circumstances, for example, down to a reduction of more than 90 per cent below the normal average range The atrophy of the thymus might perhaps have been accounted for simply as a feature of the general inanition a similar change is seen in vitamin B deficiency and sometimes in starvation yet this explanation seemed unsatisfactory Loss of weight, for example in vitamin A deficiency, does not always produce such an effect

In searching for a meaning for the atrophy of the thymus, and bearing in mind that the other manifestations of hypervitaminosis were the opposite to those of vitamin D deficiency, one could not overlook the suggestive fact that in clinical rickets the organ is indeed frequently hypertrophied Yet current physiological text books are unanimously in agreement with a recent monograph on the thymus (Hammett, Berlin, 1928) which asserts that "the function of the thymus

is unknown." Similarly it was authoritatively stated (Park, *Physiological Reviews*, 1923) that a belief that the thymus was concerned in calcium metabolism had "been challenged and overturned." However, on assembling the relative material one is confronted, once more, with a significant set of observations which, although mostly long since forgotten, and originally given a far different emphasis and interpretation, have for the most part been confirmed or extended.

(1) Atrophy of the thymus occurs in hypervitaminosis D (this is, *hyper*phosphatæmia, hypercalcæmia, hypercalcification, etc.) (Harris and Moore, 1929; Harris and Stewart, *Biochem. Jour.*, 23, 207; 1929.)

(2) Hypertrophy of thymus occurs, conversely, in rickets (that is, *hypo*phosphatæmia, etc.) (Marfan, 1922).

(3) Extirpation of thymus gives rise to rachitic lesions (Basch, 1906; Klose and Vogt, 1910; Matti, 1913), or to a typical osteomalacia (Scipaldes, 1919), or, in birds, to a deficiency of shell (or albumin) in the eggs (Riddle, 1924).

FIG. 1.—On right hypervitaminosed rat (after 8 days feeding on synthetic diet containing 0·1 per cent of irradiated ergosterol) showing disappearance of thymus. On left a normal control litter mate (fed on non irradiated ergosterol) to show the size of normal thymus (marked in solid outline in key diagram at side).

(4) Similarly atrophy of thymus, induced by thymotoxic serum, was accompanied by diminished density of and lowered CaO, MgO, P_2O_5 content of bone (Ogata, 1917).

(5) Conversely, grafting of thymus into a normal animal results in increased compactness of its bone (Demel, 1922).

(6) Feeding of thymus to salamanders in the larval stage (that is, when they have as yet no parathyroids) produced typical tetany, relieved by calcium administration (Uhlenhuth, 1918).

(7) The thymus partly involutes at adolescence.

With these observations before us, there seems no escape from adopting as a working hypothesis the view that the thymus is involved in calcium and phosphate (the two are interconnected) regulation. Thus, if one assumes, as a simplest form of this hypothesis, that the thymus is concerned in promoting calcification, one can explain very readily the facts summarised above. In rickets the organ would be hypertrophied as a result of 'overwork'; the reverse effect would naturally be seen in excessive vitamin D intake; excision of the thymus clearly would tend to prevent normal calcification, while thymus grafting or feeding would obviously have the reverse tendency; and, finally, there would certainly be a lessened need for such an organ once the laying down of the bony frame had been concluded, at adolescence.

As already indicated, several of the observations recorded above have been overlooked or disputed. In the latter connexion it is easy, however, to see why some difficulty was experienced in confirming any early work in relation to rickets; for at the time the various causative factors (Ca : P balance, vitamin deficiency) were far from being understood, so that even in control animals experimental rickets could not be satisfactorily produced. For example, it is sufficient to mention that the accepted disproof of any possible connexion between the thymus and calcium metabolism rested on evidence no more substantial than that of Renton and Robertson (1916). These workers dismissed the possibility of a relationship between rickets and the thymus on the grounds that they found it impossible to keep their normal control dogs any more free from rickets than they did their thymectomised dogs. With modern technique and knowledge different conclusions may be drawn.

The parathyroids, as is now well known, must be included among the factors concerned in calcium regulation. Admittedly, the mechanism of calcium metabolism as a whole is complex, and it is further certain that interrelations between the thymus, parathyroid, and other organs of internal secretion must become involved, quite apart again from separate questions of absorption in the gut under the control of vitamin D. The intricacies of the question cannot be gone into here, except to emphasise that it is desired to say nothing which might appear to exclude the other apparent activities of the thymus (in relation to the lymphocytes, or to the bone marrow, or nuclear metabolism), or, again, to draw a distinction between the thymus and other lymphoid tissue. But, in the almost unexampled chaos which prevails in the extensive literature describing the supposed functions of the thymus—'antitoxic', 'immunological', 'sexual', 'epithelial', and so forth—or its supposed irregularities, status lymphaticus and the like—a single working hypothesis which serves like the above to unify so many experimental observations deserves careful consideration.

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The Quantum Theory of the Kinetics of Homogeneous and Heterogeneous Reactions

CLASSICAL physical chemistry cannot explain a whole number of questions connected with the kinetics of homogeneous and heterogeneous reactions. For the explanation in particular of unimolecular reactions the constant of velocity of which does not depend on pressure, it is necessary to postulate a more or less complex mechanism (Lindemann, Lewis and Perrin, etc.). A number of investigators (Oppenheimer, Bourgin) have recently pointed out that, from the point of view of quantum mechanics, spontaneous disintegration of molecules which had not received the activation energy required by the classical theory is possible. In the present communication we give some preliminary considerations resulting from a study of the problem of kinetics of reactions.[1]

If spontaneous disintegration of the molecule is possible, there must be supposed a mechanism analogous to the mechanism of emission of α particles by the nuclei of radioactive elements (Gamow), or ionisation of an atom by the outer electric field (Oppenheimer) or Auger effect. These phenomena may be schematised, as was done by Gamow in his case, making use of the idea of the transition of particles through the

potential jump Similarly, quantum mechanics describe the emission of electrons from metals effected by the electric field (a number of papers by Fowler and Nordheim, and others) In the case of spontaneous disintegration or rearrangement of the molecules, we may assume, for example, the scheme shown in Fig 1, of dependence of the potential energy on the distance between the parts of the molecule, where A is the activation energy of the molecule, W the

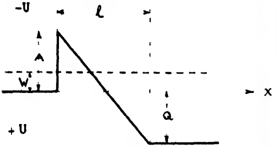

FIG 1

vibrational energy, Q the heat of reaction, and l the distance from the equilibrium position in which the molecule ceases to exist as a whole

Assuming for this scheme the probability of disintegration (or rearrangement) at $|A| > |W|$ to be approximately

$$D(W) = (4/|A|)(W)^{\frac{1}{2}}(|A| - W)^{\frac{1}{2}} \exp - \frac{4k(|A| - W)^{\frac{3}{2}}}{3a(Q - A)/l} \quad (1)$$

where

$k^2 = 8\pi^2 m/h^2$ (Fowler and Nordheim, $F = a(Q - A)/l$), taking $D(W) = D_1(W)$ at $|A| \leq |W|$ (Fowler and Nordheim, *Proc Roy Soc*, 119, 181, 1928) and using the formula

$\frac{M}{\sqrt{T}} e^{-W/kT}$ for the probability of the state with the energy W, we obtain for the constant of velocity of the reaction (v)

$$v = \frac{\beta M}{\sqrt{T}} \left[\int_0^A e^{-W/kT} D(W) dW + \int_A^\infty e^{-W/kT} D_1(W) dW \right] \quad (2)$$

where βM is the proportionality coefficient

The character of the function $v(T, Q, A, l)$ obtained by different methods is qualitatively confirmed by experimental data A similar formula (expressing the dependence on temperature) was obtained by Bourgin

The analysis of the assumptions on which the deduction of the formulæ is based, and their detailed comparison with experiment, will be given in a subsequent comprehensive paper For the present we may point out that the heat of activation A, contained in them, is not identical with the heat of activation determined experimentally from the temperature dependence of v

According to (2), v is independent of the concentration, which is in agreement with the well known properties of typical unimolecular reactions However, the influence of temperature on the vibration levels of the molecule is such that it renders possible the formation of Bodenstein's energetic chains, which cannot exist under very low pressures Only in the presence of chains can the almost complete cessation of the unimolecular reaction under very low pressures be accounted for (Sp[illegible]er)

The influence of the surface on the reaction cannot be reduced simply to a superposition of a field of double surface layer on the molecule The phenomena of catalysis require another treatment, but they also appear to be fully explained from the point of view of quantum mechanics We should consider disintegration of a molecule as a phenomenon analogous to spontaneous ionisation of an excited helium atom Both the component parts of the molecule should be considered like two electrons of helium This is connected with the probable emission of free atoms into the volume during absorption

It is also evident that, from this point of view, the unimolecularity of the majority of reactions, taking place in the superficial layer, can be easily explained (spontaneous disintegration becomes possible near the surface) as well as a series of other peculiarities of catalysis (the action of promotors, interface action, etc)

In a similar way there follows from it the increased probability of the disintegration of molecules when united into complete aggregates (or under increased pressure) The same circumstance provides a method of extension of quantum mechanics to reactions of a higher order Thermodynamic considerations lead to analogous conceptions, if we assume the equilibrium process to be unimolecular in one direction and a reaction of higher order in the other

S ROGINSKY
L ROSENKEWITSCH
Physical Technical Röntgen Institute,
Leningrad, Dec 26, 1929

[1] After this communication had been posted there was pointed out to us the preliminary paper of Langer (*Phys Rev* 37 92 1929) devoted to the quantum mechanics of chemical reactions This communication (and especially our further investigations) seems to us to have an interest of its own, since we put the question (and solve it) in a way which differs in many respects from Langer's (*Added in proof*)

Galls

THE paradoxical interrelationship between the plant and the gall producer, the larva, led to a correspondence between Mivart, Romanes, and other biologists, which appeared in NATURE of 1889 and 1890, and has since been extensively reproduced in works on cecidology, such as Kuster's "Die Gallen der Pflanzen" (pp 365 372, 1911) I have attacked the problem from a purely chemical point of view, my results leading me to the conclusion that the interrelationship between the gall producing larva and the plant may be regarded as one of inter compensation

In 1786, Scheele recorded the observation that *freshly collected* galls produce gallic acid from gall infusions, and that old galls are not capable of inducing this reaction This was confirmed by Robiquet, senior (1836), and Robiquet, junior (1854), but was discredited by Van Tieghem (1868), who concluded that the previous workers had been dealing with material infected by *Aspergillus* and *Penicillium*, which fungi have since been shown by Fernbach and Potevin (1901) to contain the enzyme tannase, which hydrolyses gallotannin into gallic acid

The remarkable fact that Scheele and the two Robiquets were so definite in their assertion led me to repeat their experiments, with the result that I have confirmed Scheele's original observations The production of gallic acid by freshly collected galls obviously shows that plant galls contain tannase, at the same time suggesting that the tannase is present in the gall producing larvæ and not in the galls themselves To test this hypothesis, the larvæ of *Pontania proxima* × *Salix caprea*, were chosen, and, using the method elaborated by Nicholson and Rhind (1924), it was found that they contain comparatively large quantities of tannase, about eight times as much as is found in the same weight of *Aspergillus niger* The gall produced by this larva had the obvious

advantage of being free from inquilines, and the larva is known to deposit its waste products outside the gall.

The presence of tannase in the larvæ of the gall producer throws new light on the points raised in the above mentioned correspondence in NATURE. It has been shown by Kustenmacher (1895), Magnus (1914), and others, that the larva lives on the plant by the production of diastase and invertase. This is counteracted on the part of the plant by an increase of tannin (thus, the oak tree contains from 5 to 10 per cent tannin, whereas oak galls contain as much as 60 per cent), which is known to precipitate both these enzymes. The decisive action, however, remains to the larva, since tannase destroys gallotannin. The accumulation of gallic acid thus produced is also effectively disposed of by the larva, as previously shown by me (1919), when I found that dryophantin (the red colouring matter of the pea-gall) is a glucoside of purpurogallin, an oxidation product of gallic acid.

These observations, which may be represented as follows:

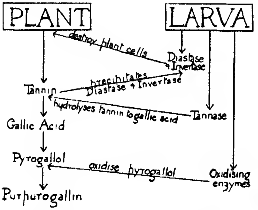

FIG 1

suggest that the interrelationship between the gall producer and the plant is therefore parasitic, the initial action of the larva being counteracted by tannin production on the part of the plant.

M. NIERENSTEIN

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The Original Mode of Constructing a Voltaic Pile

A SHORT time ago I had occasion to turn up a number of papers in *Nicholson's Journal* on early electro-chemical research in England. I was puzzled to find there certain statements regarding Volta's pile which, at first sight, seemed directly at variance with modern views.

Nicholson and Carlisle, after constructing a pile "of seventeen half crowns with a like number of pieces of zinc and of pasteboard soaked in salt water", showed by the aid of Bennet's electrometer that the silver end of the pile "was in the minus and the zinc end in the plus state".

At first, I believed this to be a mistake in the text, but the same statement was found in the early papers of other workers, for example, William Cruickshank, Colonel Haldane, and Humphry Davy. Davy and Cruickshank each state that hydrogen and metals (or alkalis) are disengaged at the "zinc wire", that is, the wire connected to the zinc plate, and oxygen and acids at the "silver wire".

Being at a loss to account for these statements—all consistent but apparently contrary to fact—I made a silver-zinc pile, arranging twenty shillings and twenty discs of zinc in series as shown, each pair being separated by blotting paper (Fig. 1).

(This is the arrangement given in most text-books of physics and is analogous to Volta's arrangement of pairs of plates in his "couronne de tasses".)

The pile gave an appreciable current when soaked in brine and behaved quite normally, liberating iodine from potassium iodide at the end of a wire joined to the silver. The apparent inconsistency was explained by a further reference to Nicholson's paper. His description of the construction of the pile is as follows:

FIG 1

"Take any number of plates of copper, or which is better, of silver, and an equal number of tin, or which is better, of zinc, and a like number of discs or pieces of card or leather, or any porous substance capable of retaining moisture. Let these last be soaked in pure water, or which is better, salt water or alkaline lees. The silver or copper may be pieces of money. Build up a pile of these pieces; namely, a piece of silver, a piece of zinc, and a piece of wet card, and so forth in the same order till the whole number intended to be made use of is builded up" (page 179, *Nicholson's Journal*, July 1800).

The arrangement of the discs is as shown in Fig. 2. Apart from a negligible contact potential difference between the two end pairs of plates, the voltage of this pile will be the same as the one represented in Fig. 1. In other words, the extreme silver and zinc plates of the series A and B (Fig. 2) are practically useless and merely conduct the current to or from the next plates. The wire connected to the silver plate will thus have the same potential as the next zinc plate, which is negatively charged, while the 'zinc wire' will have the same potential as the next silver plate (positively charged). This construction was evidently the outcome of the theory of Volta, who regarded the points of contact of the pairs of plates as the main source of the electrical energy.

FIG 2

W. CAMERON WALKER.

Minchenden School,
Southgate, N. 14, Jan. 21.

Colours of Inorganic Salts

PROF. SAHA's suggestion (NATURE of Feb. 1, p. 163) that colour in inorganic compounds depends upon the existence of an electronic state of the metal ion separated from the ground state by about 18,000 wave numbers finds some support at least from work which has been begun here upon the general problem

of crystal spectra There is a mass of evidence for his theory from the study of the rare earths (see particularly Freed and Speeding, *Phys Rev*, September 1929), but since the rare earths are exceptional because of the incompleteness of an inner quantum group with a consequent shielding of f electrons in it, it is more interesting to consider the spectra of chromium salts

The absorption spectrum of a crystal of anhydrous chromium chloride does not, of course show the sharp lines characteristic of rare earth salts As Stoner has shown, for any transition element where the incomplete quantum group is of highest total quantum number there is an interaction between the l moments of the ions in the lattice, that is, in the crystal of a chromium salt the outer electrons of each chromium ion exert an effect upon the outer electrons of the ions near to it in the lattice Actually, there are for $CrCl_3$ four or possibly more bands between 5700 and 7200 A, the bands, much broader than the lines of rare earth salts, are yet narrow compared with the shapeless bands common in crystals and solutions, and show the spectroscopic effect of the l interaction Besides these bands in the red, there appears to be a similar but weaker system in the blue-green Either of these systems is within the limits of Saha's prediction

Unpublished work on a number of crystals of hydrated and complex salts confirms the supposition that the fairly narrow bands in the red and blue are due to Cr^{+++} The bands are unaltered in frequency and seem usually to be sharper than in the anhydrous salt It may be that the sharpening is a real effect, due to the weakening of the l interaction by the presence of the co ordinated electrons from the H_2O groups, this would lead to $\sqrt{l(l+1)+4s(s+1)}$ rather than $\sqrt{4s(s+1)}$ for the magnetic moment (in Bohr magnetons) of such a co ordinated ion The magnetic evidence, which is scanty, is against this, and it may easily be that the sharpness is a matter of quality of the crystals examined

Besides the narrow bands, however, a broad structureless region of absorption from the green to the orange occurs in the spectra of all hydrated Cr^{+++} salts It seems to be caused by the co ordination electrons, and is similar in position to the only band given by the CrO_4 and Cr_2O_7 ions At low temperatures the Cr_2O_7 band has been resolved by Obreimov into a structure which is probably caused by Cr - O vibrations of different (n', n'') values, the effect of lowering the temperature is, first, the lessening of l interaction, and secondly, the simplification of the vibration possibilities of the ground state (The effect can be seen by considering the Boltzmann distribution over the intra-group (Cr - O) vibration, of the order of 500 wave numbers, and the lattice frequencies associated with it, of the order of 50 wave numbers)

It is expected that chromium salts will soon be examined at low temperatures, and it should not be difficult to decide upon the cause of the band introduced by the co ordination electrons The comparison between $CuSO_4 5H_2O$ and $CuSO_4$ is enough to show further that transitions of low energy content are made possible by the electrons of co ordinated groups, at the moment it is not certain whether the transitions are confined to the co ordinating electrons, or whether the co ordinating electrons merely have a disturbing effect upon the incomplete group of the ion concerned The answer, particularly for groups of different kinds co-ordinated in various numbers, will bring detail to our knowledge of co ordination

Until this is worked out, any account of colour in the compounds of transition elements is incomplete Of the two possible causes, the one defined by Saha is known and can usually be predicted, the other, which can happen through the formation of complex ions from atoms the incomplete quantum group of which is of highest total quantum number, is still unknown

C P SNOW
F I G. RAWLINS
Laboratories of Mineralogy and Physical Chemistry, Cambridge, Feb 5

Angular Leaf-Spot Disease of Cotton

Bacterium malvacearum, the causative agent of 'black arm', or angular leaf spot disease of the cotton plant, has been described in certain recent papers as capable of producing a systemic infection of the plant without, however, causing any manifest symptoms of disease until external conditions become suitable for the development of local lesions Further, it has been claimed that this infection may extend to the developing ovules, so that internally infected seed results, which on germination may give rise to infected plants, the degree of such infection being conditioned in large measure by the soil temperature prevailing at the time of germination

These hypotheses were of such importance that a grant was made by the Empire Marketing Board to the Rothamsted Experimental Station for the construction of apparatus in which soil and air conditions are independently controlled A number of experiments have been made on cotton plants growing in this apparatus, and certain conclusions relating to the above mentioned theories have been reached Cotton seed from the Sudan derived from heavily infected plants, and therefore on the above theory presumably internally infected, was grown at a range of soil temperature with all other environmental factors constant Seed which had been thoroughly disinfected externally produced seedlings showing no infection at any temperature Seed sown untreated resulted in seedlings with a small degree of infection, showing a maximum at a soil temperature of about 27° C Plants from seed which had been soaked in a strong suspension of the organism showed a considerably greater degree of infection, again with a maximum at 27° C, but with some disease even at 40° C (a temperature several degrees above the maximum at which the organism has been grown in pure culture) Finally, seed in which the organism had been artificially introduced within the seed coat produced seedlings nearly all of which were infected at all temperatures, even up to 40° C It will be seen that these results lend no support to the hypothesis of natural internal infection, but indicate that primary infection arises from the attack of bacteria present on the outside of the seed

In order to test the theory of latency of the parasite within the plant, these same seedlings which had shown primary infection were allowed to grow on under conditions suitable for the development of the disease, as shown by the fact that plants side by side with them which had been sprayed with a pure culture of the organism developed heavy infection In no case did the unsprayed plants show any further disease in the newly formed leaves and stems as would be expected if the theory of internal spread were correct A detailed account of these experiments will be published at an early date in the *Annals of Applied Biology*.

Returning to the hypothesis of internal infection of seed, attempts in the laboratory to isolate the organism from the tissues of the embryo have invariably failed Many different kinds of organisms, both fungi and bacteria, occur, however, between the

seed coat and the embryo, and on one occasion out of many trials *B malvacearum* was recovered from this position

A point of interest, and one which may prove to be of great importance in the life history of the disease, is that this bacterium has been found to show the phenomenon of 'dissociation' At least three 'dissociates' have been isolated, all of which are culturally, and to some extent morphologically, quite distinct, one being possibly identical with the so called 'common yellow saprophyte of cotton' These 'dissociates' arise in single cell cultures and appear to be produced in an obligate order, that is, 'A' produces 'B', 'B' produces 'C,' and so on, there being some suggestion that the cycle may be a closed one This phenomenon of dissociation appears to be correlated to some extent with the production of some of the newly observed growth forms recently described by me (*Proc Roy Soc*, B, **105**, 1929)

R H STOUGHTON

Department of Mycology,
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Glasses Transparent to Ultra-Violet Radiation

IN his letter to NATURE of Jan 18, Dr English suggests that our conclusion (NATURE, Sept 21, 1929) that "complete degeneration by a mercury arc lamp results in a greater loss of ultra violet transparency than does natural solarisation", is merely a confirmation of his statement (*Glass*, Sept 1928) that eight hours' exposure to a mercury vapour lamp is equivalent to six months' exposure to sunshine

So far from confirming his statement, we cannot even agree with it We have proved quite definitely that an exposure of two hours at a few inches from the mercury vapour lamp produces far more degeneration than would an eternity of sunshine

Dr English appears to ignore completely the most interesting phenomenon of the rejuvenation of ultra-violet glasses in sunshine *after* being degenerated by mercury vapour lamps Our letter was concerned almost entirely with this discovery, which to our minds proves conclusively that exposure to lamps emitting radiation of wave lengths shorter than that received from the sun can be no safe guide to the behaviour of glasses when exposed to sunshine We understand that this discovery of the phenomenon of rejuvenation of artificially irradiated glasses has already been confirmed by the Bureau of Standards

We are surprised that Dr English prefers to substantiate his arguments with photographs of spectra, surely a dangerous procedure—he himself condemns it (*Glass*, September 1928, pp 388, 389)—rather than to consider figures, accurately determined, showing the actual percentage transmission of specimens of identical thickness under different conditions We believe that all accepted authorities agree that the only trustworthy methods for the comparison of specimens of glass are those employing a photoelectric cell, vacuum thermopile, or similar quantitative instrument One such method was described briefly in our letter (NATURE, Sept 21, 1929)

We did not say in our letter that natural solarisation was complete in a few days Our figures show, however, that it can be practically so in four very bright days

New glass exposed in winter will, of course, age slowly compared with that exposed in summer

A R WOOD
M N LEATHWOOD

Research Laboratory,
Crown Glass Works,
St Helens, Lancs, Jan 23

Monomolecular Films of Batyl Alcohol

SOME measurements which I have made on mono molecular films of batyl and chimyl alcohols (isolated from shark liver oils by Prof J C Drummond) throw some light on the molecular structure of these compounds They have been shown to be, respectively, an octadecyl glyceryl ether (Heilbron and Owens, *Jour Chem Soc*, 942, 1928) and a cetyl glyceryl ether (Drummond and Baker, *Biochem Jour*, **23**, 274, 1929), whether the hydrocarbon chain is attached to the glyceryl group at the α or β carbon atom has not hitherto been decided

My measurements give 26 sq A for the cross section of the head group of batyl alcohol This agrees with the value for the α monoglycerides (Adam, Berry, and Turner, *Proc Roy Soc*, A, **117**, **532**, 1928) If batyl alcohol had the symmetrical β structure, its mode of orientation would require a larger area than this, comparable with the 36 sq A found for mono octadecyl malonic acid (N K Adam, private communication)

In view of these facts, therefore, it seems highly probable that batyl and chimyl alcohols have the unsymmetrical α structure

B C J G KNIGHT

Bacteriological Department,
London Hospital Medical College, E 1,
Jan 23

Viruses and Life

MR GEOFFREY SAMUEL states in NATURE of Jan 11, p 51, that he has difficulty in distinguishing the suppositions vitamol and virus Virus connotes a something of unknown constitution that can pass through filters and that causes specific disease Vitamol is supposed to be of molecular structure with attributes of life, and might be parasitic or symbiotic or lead an independent existence In the study of the viruses the methods of the biologist seem to have reached their limit, and the concept and the word were offered in the hope of attracting the attention of physicists who might be able to cast a ray of light on the matter

If structure is for function and not function for structure, then function should precede For the development of structure that facilitates metabolism (say an envelope having certain qualities) there should be metabolism to facilitate

In the broad theory of evolution there is at present a hiatus between the non living and the living, a gap which the theory requires should be bridged

J J DAVIS

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A Deep Sea Echinoid in British Waters

ON Feb 13 we took a single specimen of the Spatangoid *Urechinus naresianus* in a bucket sample at 110 metres, seven miles south of Sanda, off the Mull of Kintyre It was a young individual only, 5 mm long The general colour was whitish, and the tube feet yellow, two or three large pedicellariæ on the aboral side were tipped with deep red The sample was a coarse shell gravel with a fairly large mixture of sand

This is the first record of the species in British waters, and with the exception of a single record at 760 metres, referred to by Mortensen as untrustworthy, its previously known bathymetric range was c 1450 to 4480 metres

HILARY B MOORE

Marine Station,
Millport

Scientific Research and Modern Life

THE recently published report of the Department of Scientific and Industrial Research[1] covers the period Aug 1, 1928–July 31, 1929 It is signed by Lord Parmoor and includes the short report of the Committee of the Privy Council, and the longer report of the Advisory Council, together with summaries of the work done under the direction of the various research boards and by the research associations which have received grants from the Department, and also appendices dealing with finance, publications, and the organisation of industrial research in various parts of the British Empire

Originally appointed by an Order in Council of July 28, 1915, the Committee of the Privy Council, consisting of the holders for the time being of certain Ministerial offices, is charged with the duty of directing the application of the sums of money provided by Parliament for the organisation and development of scientific and industrial research The gross estimate for the present year is £644,379, of which £31,071 is for headquarters administration, £32,000 for grants, £512,570 for research work and research establishments, and £68,738 for the Geological Survey of Great Britain and the Museum of Practical Geology, the administrative control of which was transferred to the Department in 1919

Much detailed information is given regarding the allocation of the money, from which it is seen that the net cost of the National Physical Laboratory during 1928–29 was £89,861, of fuel research £77,877, of building research £32,362, of forest products research £34,327, and of food investigation £18,546 Of the various research associations, during eleven years the British Scientific Instrument Research Association has received £100,484, the Woollen, Cotton, Linen, and Rubber Research Associations in nine or ten years have received respectively £54,643, £92,662, £57,282, and £30,983, while altogether twenty three associations have received grants The total expenditure on the National Physical Laboratory was £195,164, but the receipts from outside bodies, firms and Government departments, amounted to £105,303

Though, considering the immense interests involved the sum at the service of the Department is comparatively small, it is probable that the influence of the work of the Department is felt in every part of the Empire, while perhaps no portion of the national income is expended with more beneficial results Agriculture, food, housing, heating, lighting, clothing, transport, and communications, all profit by the investigations either directly carried out by the research boards or assisted by the Department, and science is not only applied to difficult industrial problems, but it is also made to minister to our everyday needs in a thousand ways The storage of fruit, the production of beet, cutlery manufacture, laundry work, flax growing, boot-making, furniture, anthrax from skins and hides, coinage, the ageing of rubber, dentists' fillings, mites in flour, the cocoa moth, water purification, fish and salt meat, are all among the things which are being investigated and will undoubtedly pay for investigating No fewer than fifty boards and committees are shown as directing the inquiries, which affect the whole population On these committees sit some of the most distinguished men of science in Great Britain, and their services to the nation are none the less valuable because in many cases they are given voluntarily These committees may indeed be regarded as a great general staff organised for the application of science to our common wants

It is impossible in a short article to do justice to the great range of subjects that fall within the province of the Department, but to illustrate the close relationship of its work and everyday life we have selected the reports of the Fuel, Food, Building, and Forest Research Boards Second in importance to none is the national question of fuel, whether used for industrial or for domestic purposes Presided over by Sir Richard Threlfall, the Fuel Research Board has local committees in all the coal producing areas and maintains the Fuel Research Station at Greenwich Of this station the Advisory Committee remarks ' We take this opportunity of expressing to Your Lordships our appreciation of the value of the work of this Station Your Lordships can be confident that we now have a national organisation for fuel research which is not excelled in any other country "

When the Fuel Research Board started its work, it gave a large degree of priority to all problems of carbonisation, these being considered of importance from the point of view of smoke abatement and of the production of oil from home resources It was also desired to stimulate industrial development Then, too, the Board was asked to advise on the composition and quality of gas for public supply In connexion with these matters, problems in both high temperature and low temperature carbonisation have been attacked with noteworthy results Now it is proposed to carry out a general investigation of furnace design with particular reference to the burning of pulverised fuel, which is being introduced both ashore and afloat The chief technical problem here is to secure complete combustion in a small space, hitherto it has been considered necessary to have large combustion spaces, but for this there does not seem to be any basic necessity The production of metallurgical coke, the manufacture of water gas, the hydrogenation of coal, and the composition of tar are all being studied An outstanding feature of the year was the starting up of the low temperature carbonisation plant at the Richmond Gas Works, erected to the designs worked out at the Fuel Research Station After preliminary difficulties were overcome, the plant was successfully put into commission, and the new domestic fuel was placed on the market as 'Gloco'

The Food Investigation Board is presided over by Sir J G Broodbank, while Mr W C D Whetham

[1] Department of Scientific and Industrial Research Report for the year 1928–29 (Cmd 3471) Pp v+200 (London H M Stationery Office, 1930) 3s 6d net

is chairman of the management committee of the Low Temperature Station for Research in Biochemistry and Biophysics at Cambridge Our fuel supplies are ample, our food supplies come from all over the world, and the successful preservation and carriage of fruit, vegetables, meat, and fish affect every home The storage of fruit has been studied for ten years, and it is proposed to publish a comprehensive report on it Special attention has been given to apples, and recent investigations show that there is a critical low temperature for each variety of apple, below which the fruit rapidly deteriorates in storage For the study of fruit an experimental station is being erected at East Malling, and for the study of fish a research laboratory is being inaugurated at Aberdeen Towards the cost of these the Empire Marketing Board is assisting The value of the fish landed in Great Britain last year was £18,000,000, the value of the meat imported, £109,000,000—figures which indicate the importance of the trade in these commodities

While many of the inquiries led to long and difficult experiments in the laboratory, an example of work of more immediate practical application arose through requests made by the Sheffield and Leicester Corporations The question was whether the hanging of meat improved its palatability Experiments were made with meat conditioned at 32° F and 41° F up to ten days hanging, and it was found that the palatability was improved, the flavour was retained, and the texture and juiciness of the meat improved In the tests, assistance was received from members of King's College for Women and the staff of Messrs J Lyons and Co

Houses, furniture, and clothing are as necessary as food and fuel, and the work of the Building Research Board, the Forest Products Research Board, and that done by the Cotton, Woollen, Silk, Leather, Boot and Shoe, and other Research Associations, afford many examples of the value of the scientific method applied to age long problems Limes, plasters, cements, paints breeze, artificial stone, the weathering of stone, the vibration of buildings, wind pressure on structures, are being investigated by the Building Research Board, while the Forest Products Research Board is dealing with the anatomical structure of woods, the seasoning of furniture timbers, the shrinkage and deterioration of timbers, the testing of pit props, and the habits of the various insects which destroy our roofs and furniture Many firms apply to the Boards for information, and, in addition to advisory work at home, much has been undertaken for places so far apart as Burma, British Honduras, Australasia, and Kenya

In other directions work is proceeding on metals and alloys, boiler plates and ingot steel, corrosion, the fatigue of metals, electro deposition, springs, radio telegraphy and telephony, lubrication, cast iron, refractories, and many engineering problems While one department is engaged on the study of steel, another is considering the advisability of establishing a national locomotive experimental station, and yet another is doing work of value for our cathedrals and churches Canada, Australia, New Zealand, South Africa, and India are all following in the footsteps of the Mother Country they all have research organisations, and of their activities the report gives a brief review

A New High Voltage Research Laboratory

THE opening by Sir Ernest Rutherford of the high voltage research laboratory of Metropolitan Vickers Electrical Co, Ltd, at Trafford Park, Manchester, on Feb 28 is a noteworthy event The increasing use of the outdoor type of construction for high voltage apparatus makes it necessary to determine how this apparatus will act during gales, thunderstorms, and snow storms As the standard pressure for distributing electrical energy in Great Britain is 132,000 volts, and a factor of safety of three or four is desirable, it is very advisable that all devices for use in high voltage lines should be tested at pressures of several hundred thousand volts

In the present state of our knowledge, the performance of insulating material under very high pressures can in general only be determined by experiment Although there are now several laboratories abroad which have facilities for testing at a million volts with a large reserve of power, yet with the exception of the high voltage equipment at the National Physical Laboratory, Teddington, there was none in England It is highly satisfactory, therefore, that one of the largest industrial firms should have built a million volt laboratory under the supervision of its able engineers

The present laboratory consists of two semi independent main buildings and an annex The smaller of the two main buildings, which is 47 ft long by 67 ft broad, was built in 1923 as a 500,000 volt power frequency laboratory When it was decided to extend the equipment to give a million volts, the second main building, 67 ft by 86 ft, was laid down with a wall in common with the original building The latter is now equipped with devices for producing transient voltages and is called the 'surge' laboratory The annex contains the materials and physics laboratories and a machine room where all the generators and running machinery are isolated so as to reduce noise

The main electrical equipment consists of two 500,000 volt, 500 k v a, 50 cycle transformers, one being located in the main laboratory and the other in the surge laboratory For producing a million volts, the two transformers are connected in cascade by the well known Dessauer method The second transformer, the one in the main laboratory, is shown in Fig 1 As the primary winding of this transformer has a potential difference to earth of 500,000 volts, the whole transformer has to be thoroughly insulated from the earth This is done by means of pedestal pillars which support the tank

containing the transformer The two transformers are practically identical in construction, each being of the core type with each limb wound They are both immersed in oil

The accurate measurement of high voltages is a problem of considerable difficulty The standard method is to use two spherical electrodes, then, if their potentials are equal and opposite at the instant of the discharge, the potential difference between them can be computed with an accuracy of about one per cent, provided that there are no brush discharges taking place in the neighbourhood When one of the electrodes is earthed, the accuracy obtainable is not so high, possibly because the potential of the 'earthed' sphere is not zero

The method adopted in the new laboratory at Trafford Park depends on the theorem that the average charging current of a condenser is proportional to its capacity and to the *maximum value* of the voltage Hence when the capacity and frequency are known and the average current due to the voltage is measured, the maximum voltage can be deduced A meter is so arranged that its reading gives the voltage directly The condenser employed consists of large surfaces, each twenty feet in diameter and having air between them (see Fig 1) The surfaces employed are flattened and symmetrical about a vertical axis One is supported directly on the bushing insulator of the high voltage transformer, and the other is suspended immediately above it from the roof This condenser is the largest high voltage condenser yet constructed

The power rating of each of the transformers is 500 kilovolt amperes, so that very large currents can be supplied at the instant of spark-over In order to get satisfactory results, it is well known that it is necessary to have a large amount of reserve power available The control of the generators which are housed in the machine room is done from the control desks in the laboratories Push buttons control the starting and stopping of the driving motors, the rheostats which govern their speed and the frequency meters The potentiometer regulators which control the voltage are motor driven and give a uniform rate of voltage variation over the entire range with the motor running at constant speed

The photograph of a power frequency arc at a pressure of 970,000 volts is shown in Fig 2 The spark gap is 12 ft The man shown in the illustration was not present when the arc occurred, if he had been he probably would have been killed. He is merely included in the photograph to indicate the scale of the phenomenon, this was done by a double exposure On first entering the laboratory, one is impressed by the large amount of floor space which is apparently not utilised Remembering, however, that at a million volts 12-ft arcs can occur, it will be seen that any material or apparatus being tested must be at least that distance away from walls and objects connected with the earth Taking the dimensions of the transformer into account, it was found that a clear space at least 30 ft in diameter was absolutely necessary

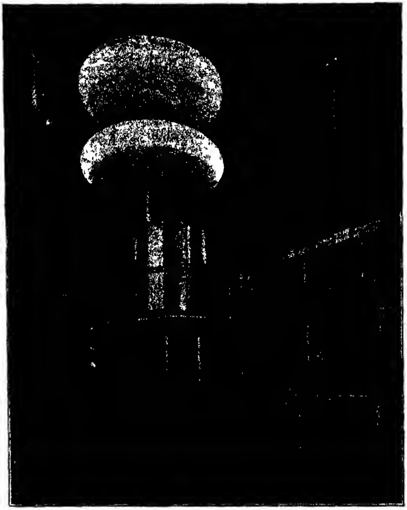

Fig 1 —Interior view of the main High Voltage Laboratory at Trafford Park

In order to make full scale tests of large porcelain insulators immersed in oil, it was found advisable to make a tank 25 feet in diameter and 10 feet in depth This has a volume of about 4000 cubic ft and would contain about 20,000 gallons of oil Good insulating oil is not cheap, so this must repre-

sent quite a large amount of capital The necessity also of keeping it dry and clean must add considerably to the cost It will be seen that these million voltage tests must be very expensive The majority of the tests will be carried out by the two transformers used individually at 500,000 volts or less In the materials laboratory there are three transformers producing voltages of 11,000, 22,000, and 100,000 for ordinary tests Two tanks are provided, for making tests in hot and cold oil There are four testing chambers in the middle of the room, where the materials can be tested at various temperatures and humidities

In the surge laboratory (Fig 3), apparatus is provided for testing devices and materials when subjected to transient voltages produced in various ways In systems used for transmitting electrical power, three kinds of surges are recognised first, those caused by a sudden variation of the load or the 'runaway' of a generator, secondly, those due to high frequency surges of internal origin caused by switching or by an arcing fault, and thirdly, the surges caused by atmospheric disturbances, including lightning discharges Modern operating experience in Great Britain where the neutral is earthed indicates that lightning is the only source of overvoltage that has to be guarded against The design of the insulators, therefore, must be such that the minimum amount of damage is done when the lightning arc over occurs The dangerous transients are the 'impulsive rushes' which were described fully and experimentally demonstrated by Sir Oliver Lodge so long ago as 1889 (*Jour Inst Elect Engin*, vol 18, p 386, 1889)

By arranging a condenser so that it is suddenly discharged when a spark gap flashes over, it is easy to get what Lodge called an impulsive rush By arranging a series of them in parallel, we can construct an impulse generator The generator in the surge laboratory can produce transient voltages up to 1,500,000 A mechanical rectifier is installed which produces a voltage of about 700,000 This is mainly used for operating the impulse generator Another set equipped with thermionic rectifiers is generally employed for direct current voltage tests Its maximum voltage is 250,000 volts, and its terminals can either be at equal and opposite voltages or one of them may be earthed

A special Schering bridge has been constructed for measuring dielectric losses at pressures up to 500,000 volts Electro mechanical tests on porcelain insulators, and design studies on switch gear and transformer parts, have frequently to be carried out in this laboratory It is one of the best equipped laboratories in the world, and Messrs Metropolitan Vickers Electrical Co, Ltd, are to be congratulated on having recognised always that it is necessary to use the best and most scientific methods of testing the materials they use in manufacturing their machines and devices and for determining their factors of safety

In declaring the laboratory open, Sir Ernest Rutherford expressed the hope that before long we may be able, by using millions of volts, to produce copious streams of high velocity atoms and electrons in the laboratory An abundant supply of swift particles would open up many new avenues of attack on the fundamental problems

FIG 2 —Power frequency arc at a pressure of 970 000 volts in a 12 ft. gap The man was photographed separately

of physics Unfortunately, the finances of the ordinary university laboratory are very limited It is too much for a university to hope for a laboratory like this one approaching a cathedral in size It is possible, however, that an apparatus may be devised which can be operated by a small

transformer in an ordinary-sized room giving ten million kilovolts to a vacuum tube Such a piece

FIG 3 —Impulse generator in Surge Laboratory

of apparatus would be a great help in physical research, and considering the great progress made by engineers in recent years, Sir Ernest believes that the design of such a device does not offer insuperable difficulties He congratulated the Metropolitan Vickers Electrical Co, Ltd, and its research department on its far sighted policy in initiating high voltage research

Obituary

MR A A CAMPBELL SWINTON, F R S

BY the death of Alan Archibald Campbell Swinton on Feb 19, scientific research loses one who has done valuable work especially in X-rays and radio communication The third son of Archibald Campbell Swinton of Kimmerghame, Berwickshire, he was born on Oct 18, 1863 His father was a professor of civil law in the University of Edinburgh from 1842 to 1862 and was also Brigadier-General in the Royal Company of Archers He could prove direct descent from the Royal House of Scotland Prof Swinton's second son was Captain George S C Swinton, who was chairman of the London County Council in 1912 and chairman of the town-planning committee of the new city of Delhi He was also Lord Lyon King of Arms Prof Swinton's sister was the mother of Archbishop Lord Davidson

When a child, Alan Campbell Swinton showed a bent towards engineering An oil painting of him when aged nine, with a steam engine in his hand, was shown at the Royal Scottish Academy

(*Continued on p* 385)

Supplement to NATURE

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Reviews

"The New Britannica"

The Encyclopædia Britannica a New Survey of Universal Knowledge Fourteenth edition In 24 volumes Each volume about 1000 pages (London The Encyclopædia Britannica Co, Ltd, New York Encyclopædia Britannica Inc, 1929) Cloth, £27 16*s* 6*d*, Half Morocco, £36 17*s* 6*d*, Three-quarter Morocco, £49 10*s*, Full Morocco, £69, Library Bookcase Table included

IN the opening paragraph of the preface to the fourteenth edition of the "Encyclopædia Britannica", the editor at once strikes the note of innovation which to coming generations will be the distinctive mark of this issue of a great publication He points out that, from the time of d'Alembert's preface to the great French "Encyclopedie" of the eighteenth century, it has been customary to prefix to encyclopædias a general dissertation upon 'the body and divisions of knowledge, its life and advancement, its inspiration and utilities" His own task he has conceived differently Such a unifying impression, he holds, and all will agree justly, has passed beyond the power of man He aims now at stating what is the spirit animating "this newest design", the scope of its contents and the methods by which the whole has been formed

'Monumental' is a word which has been sadly overworked in relation to the heavier literature of to day and yesterday, but no other is more readily applicable to the "Encyclopædia Britannica" With equal propriety it may be termed "more lasting than brass" Each successive edition falls out of date as the volume of knowledge increases, but each remains a landmark in the progress of man towards the completer conquest of his environment—not in the sense merely of his control of material conditions, but in the spiritual knowledge which ultimately informs all interpretations of the universe and its component parts, however much we may try to anchor them to earth with such labels as 'materialistic' and 'mechanistic'

In every great encyclopædia which is worthy of that name the spirit of the age takes on bodily form This is as true of the fourteenth edition of the 'Encyclopædia Britannica' as it was of the ninth and as it was of the first edition one hundred and sixty years ago Yet if we would contrast to day with yesterday, or perhaps more aptly the day before yesterday, we should look to the great "Encyclopédie" of Diderot and d'Alembert rather than to the "Britannica" That momentous French compilation of the eighteenth century sounded the death knell of the old regime It focused the scepticism of which Voltaire was the protagonist, the idealism of which Rousseau was the prophet, and the realism of Montesquieu and the natural philosophers it gave general currency to ideas which were to be a driving force in philosophy, in science, in literature, and in politics throughout the French Revolution and the troubled times in Europe of the first half of the nineteenth century

This spirit still lives Yet if we seek to draw a parallel in the conditions of this newer world and the old, it is the ninth edition of the "Encyclopædia Britannica" rather than the fourteenth which we would compare with the "Encyclopédie" Just as the latter inspired the French Revolution and its immanent philosophic ideals, the ninth edition paved the way to a revolution in every department of human life which was no whit less far reaching than the political upheavals of the eighteenth and early nineteenth centuries, and of which no one can yet foretell the full effect When the publication of the ninth edition began in 1875 the world was still orthodox The ideas of Darwinism had not yet gained currency their full implication—all that body of healthy scepticism for which they now stand to us—had not been generally perceived, much less had their ramifications been worked out The leaven had only begun to leaven the lump Fourteen years later, when publication was complete, the viewpoint of science and philosophy, of literature and art, was changing from the static to the dynamic We are no longer in the fixed conditions of a settled universe Once more the inquirer stands with the first prophet of evolution in a world of flux and can exclaim with Heracleitus πάντα ῥεῖ

Yet the very moment in which the philosopher seemed to grasp the key which would open the door to the secrets of the universe witnessed the shattering of his hope The spirit of inquiry which had been released by the break up of the orthodox world, turned to rend its deliverer On one hand, the sum of knowledge rapidly passed beyond the comprehension of a single synthetic scheme on the other, the teleological concepts which had been coupled with the evolutionary theory failed to make good their validity—a fortunate chance, can it be called, otherwise had the world of intellect been confined by an idealism as sterilising in the long run as the orthodox conceptions of the mid nineteenth century

It is almost a commonplace of criticism to regard the generation which has followed the later years of the nineteenth century as materialistic A more just interpretation of the intense preoccupation with facts which is perhaps the most salient characteristic of that generation would attribute it rather to the extension of scientific method to all branches of knowledge Most marked, perhaps, is the application of that method to departments of life which, if hitherto regarded vaguely as subject to general laws, under a regime of *laissez faire* had in practice been left to a more or less informed employment of the method of 'trial and error'

In those sciences of which the subject matter is susceptible of study by experiment, there has been in the present generation an enormous increase in the volume and intensity of research But in the biological sciences, more especially in those which bear upon human life, the range of experiment is limited Here, however, research has been prosecuted with no less activity This has been rendered possible by a continually increasing appreciation of the degree to which observation can be made to serve the purpose of experiment By a widely extended record of facts observed in varying conditions which afford material for contrast and comparison, methods of study have been formulated analogous to the 'control' of the experimental laboratory It is in the light of this conception that there has grown up in little more than a generation the vast body of knowledge which is comprised in the study of heredity and that, very slowly it is true, the study of genetics, of eugenics, of anthropology, and of sociology are collecting facts and formulating principles which are becoming more and more the background in the work of social welfare and to a degree in actual legislation The effect of scientific method in the attack on the problems of hygiene and public health is too obvious to need comment

It is, however, to the War that we must look for the most potent stimulus, both directly and indirectly, to the extension of scientific research and to the increased application of its results to the practical affairs of life The War was universal in its effect The struggle was not confined to the trenches, 'supply' was not merely a question of maintaining an army in the field There was no department in the life of the nation so remote that it was not vitally affected If chemical warfare was the most obvious province of research, it was one only of many Every effort was demanded from science to help to conserve and extend the resources of the nation in the vital services of life

For those who look to a scientific attitude of mind as an essential factor in the attack on the many and grave problems of this post War world, it is of the utmost moment that the significance of science during the War has not been entirely forgotten The diversion of practically the whole body of scientifically trained men in the country to the service of the nation made the public familiar with certain principles On one hand, it came to appreciate that scientific research, however apparently remote its object from practical affairs, still has its value, and, on the other, that even in problems in which science is not directly concerned, the scientifically trained mind and 'scientific method' in mode of attack minimise effort and offer the greatest promise of an ultimate solution Hence since the close of the War a change of attitude towards science has to be noted as an element in the formulation of popular opinion The age of reason, however, is not yet Polities still govern legislation But the attempt, for example, which is being made to formulate basic principles in accordance with scientific fact in questions so tinged with emotion as marriage and divorce is at least significant

We may appear to have wandered somewhat far from the "Encyclopædia Britannica", but these reflections occur inevitably when both its new form and content are considered It is a product and a reflection of its age as much as earlier editions have been At the present day science workers are overwhelmed with the volume of research Each becomes increasingly absorbed in his own restricted field Specialisation grows from day to day, and no one can hope to keep fully abreast with advances in fields other than his own The editors have therefore had a difficult task to perform The general essays, in their day highly valuable contributions to the advancement of knowledge, which

have been a feature of earlier editions, have tended to disappear In their place, greater subdivision, entailing a great increase in the number of separate articles, more detailed treatment, and an increased volume of specific information so far as consistent with due regard to the broader outline of each subject, are the salient features of the new edition Again, borderline territories between the sciences and the interrelation of different sciences, a conspicuous feature in modern research, have had to be adequately covered It is therefore no matter for surprise to find that the whole editorial organisation has been fundamentally changed in the preparation of the latest edition The editorial staff has been supplemented, in fact except in its highest functions superseded, by a body of departmental specialist editors Not only has this given an added guarantee of accuracy, it has ensured a fitting perspective within each department

A perusal of the list of associate editors reads like a ' ministry of all the talents " Without attempting to give a complete list, a few of the more suggestive names may be mentioned Prof Andrade is responsible for physics, Prof Barcroft for physiology, Dr Cloudesley Brereton for education Geography is in the hands of Prof H J Fleure Prof Julian Huxley is responsible for biology and zoology, and Prof G T Morgan for chemistry Mr T C Hodson edits archæology and anthropology, and Prof A S Eddington, astronomy It is unnecessary to pursue the list further This brief selection suffices for a taste of its quality In addition, as the 'Encyclopædia" is essentially a result of Anglo American co operation, a corps of associates, each a recognised expert, was organised in New York, thus effectually securing the full representation of American scientific achievement

Of the quality of the sections for which the associate editors have been responsible, and of individual contributions, we hope to speak in later issues For the moment it must suffice to say that the new organisation has fully justified itself As a work of reference and a source of information on points of detail, the value of the "Encyclopædia", speaking generally, has been much enhanced The illustrations alone in themselves are a store of information, and both from the artistic and technical point of view are a remarkable achievement It is, perhaps, hazardous to prophesy that this edition of the "Britannica" will be regarded as a permanent possession for generations to come, it will certainly long be regarded as a monument of technical excellence in book production

Bacteriology in Medicine

Medical Research Council A System of Bacteriology in relation to Medicine Vol 4 By H J Bensted, W Bulloch, L Dudgeon, A D Gardner, E D W Greig, D Harvey, W F Harvey, T J Mackie, R A O'Brien, H M Perry, H Schutze, P Bruce White, W J Wilson Pp 482 (London H M Stationery Office, 1929) 21*s* net

THIS volume is divided into seven chapters, of which the first four are devoted to the coli typhoid group of organisms All the writers have special knowledge of the subjects with which they have dealt, and the majority have had considerable practical experience in the medical aspect of the disease of which the bacteriology is described As would be expected, therefore, the articles are of a high standard Every chapter gives evidence of a very painstaking and weary search through, not only recent, but also somewhat ancient, literature, and some of the chapters must have involved an enormous amount of practical investigation, in fact, it is doubtful whether the book has not suffered to some extent by the publication of the results of elaborate researches which are more of academic interest than of practical scientific value That problems of scientific bacteriology are at present in a somewhat unstable condition is seen in several of the chapters, and it would, we think, have been better if the work of some of the researchers had been held back until more certainty had been attained

In the review of Vol 3, we criticised the position of some of the chapters, and even the desirability of including them in that volume The same unfortunate grouping is again manifest in Vol 4 The separation of the *Pasteurella* group and B *pseudotuberculosis rodentium* from the chapter on B *pestis* in Vol 3 is an example of this The close relationship between these organisms is admitted by the author He says, "Two bacterial species, B *pestis* and B *pseudotuberculosis rodentium* to which the Pasteurella are most closely related " This may be regarded as a small defect, but surely in a work of the standing of the present one, it is desirable that some definite arrangement of the material should have been made and that chapters dealing with very closely related bacteria should have been in one group, or at any rate in one volume, and not separated by chapters dealing with entirely different subjects

Chap 1 deals with *Bacillus typhosus* With his usual clearness and accuracy, Bulloch writes a very interesting, short history of the organism, and an

account of the practical diagnosis of typhoid and para-typhoid, by Perry and Bensted, will prove of great value to all who are dealing with the subject from the clinical side, though more detailed consideration of some points, such as the parts dealing with blood culture, would have improved it The main part of this chapter is by D Harvey, and it is a valuable contribution to the literature of typhoid fever There is nothing new about the article, but it is an excellent summary of a vast amount of original work by other workers The author has dealt very fully with all the important aspects of the bacteriology of this disease, and has not over-emphasised minor points It seems unnecessary, however, still to maintain the old statement, repeated in almost every text book on bacteriology, of the number and length of the flagella No one has a successful stain for them and the necessary manipulation must render a count and a measurement utterly valueless

Again, on p 18—" Blood At one time it was stated that the finding of Gram negative bacilli in the blood was a possible method of diagnosis of typhoid fever But it must be remembered that to obtain a successful culture it is, as a rule, necessary to take at least 5 c cm of blood It is obvious, therefore, that the chance of discovering a bacillus in a drop of blood is remote "

It is correct to say that the finding of the bacillus in the blood is a method of diagnosis, and surely no bacteriologist would misinterpret the statement in the way suggested in the latter part of the paragraph

Chap ii, on the *Salmonella* group, is by P Bruce White Most bacteriologists have worked on this group, and all such must recognise the enormous amount of work this chapter has demanded It is not merely a careful review of the very numerous communications on the subject, but much is his own experimental work That kind of work is very laborious and exacting, and the results are of a very high scientific value We find it somewhat difficult to appraise its real value, as so many points can only be fully appreciated by those who have themselves worked at the intricate details given in relation to the types, serology, etc, of this group of bacteria The chapter must be placed as one of the best, if not the best published statement of this group, and will remain a standard of reference for workers on bacteriology It would, we think, have been better if the details given on p 101 about the "H" and "O" antigenic variations had been given before the reference made to them on p 88 had been written

The pathology of these infections is dealt with very imperfectly and contrasts unfavourably with that of the organisms dealt with in the other chapters To many of those who are dealing with *Salmonella* infections the pathology is important, and they will get little information of value from this article The chapter would have been improved if this aspect of the infections had been dealt with by an author familiar with the clinical manifestations of the diseases caused by this group of organisms In spite of these defects, the value of this chapter to bacteriologists cannot be over-estimated

In Chap iii, on the dysentery group of bacilli, a short history is given by Dr Bulloch, and a brief article, containing the essential details on the production of toxin and antitoxin on the large scale, is written by Dr O'Brien Both are well done The rest of the chapter is divided between Dr Gardner and Prof Dudgeon The whole chapter gives a very complete account of the bacteriology of this disease A specially valuable feature is the full way in which practical diagnosis in infections with *B flexner*, *B shiga*, and *B sonne* is discussed

Chap iv, by W J Wilson and W Bulloch, deals with the Colon group and similar bacteria This chapter will prove of great value to all workers on the subject The information is exhaustive, the arrangement good, and the writing clear

T J Mackie, E D W Greig, and W F Harvey have contributed Chap v, on the cholera vibrio and related organisms The history is again by W Bulloch and no comment is necessary Various aspects are dealt with very fully by the different authors There seems to have been a lack of close co operation between the authors, and the statements made by each are not always in agreement To take only two examples in the examination of water, Greig emphasises the importance of taking surface water for examination Mackie makes no reference to this important fact Greig and Mackie, in dealing with selective media for enrichment, give, in the main, entirely different methods Apart from points of this kind, the whole article is well written and is very accurate and full, and is the work of men who have had considerable practical experience in the bacteriology, epidemiology, and diagnosis of this disease The discussion of immunisation in this disease, by Dr Harvey, is a valuable addition to the chapter With the exception of a few minor points, the part by Greig on the pathogenic action of these bacteria is in keeping with the general excellence of the chapter

Chap vi is by H Schutze I have already referred to the misplacing of this chapter It is perhaps the most unsatisfactory part in the book,

not, however, because of the material and its manner of presentation, but because of the present unsatisfactory grouping of these organisms Dr Schütze had made the best of the material at his disposal

Taken as a whole, the volume under notice will be welcomed by all bacteriologists It should find a place in every medical library, and to the bacteriologist it will be a most welcome guide in all aspects of his work Authors and editors are to be congratulated on this production J M BEATTIE

Petroglyphs of California and Adjoining States

University of California Publications in American Archæology and Ethnology Vol 24, No 2 *Petroglyphs of California and adjoining States* By Julian H Steward Pp 47 238 + plates 22 94 (Berkeley University of California Press, London Cambridge University Press, 1929) 2 50 dollars

THIS publication is issued by the Department of Anthropology of the University of California It contains much that is of great interest to the student of primitive art, for it is concerned with a quantity of drawings which occur throughout California, being mostly executed on vertical rock surfaces There are both carvings and paintings, consisting for the most part of highly conventionalised figures of men and animals as well as what can only be classed as geometric patterns, and the whole forms a most interesting art group

Although the rock drawings of California itself are the author's chief concern, he has included in his survey those found in neighbouring States, since, naturally, modern political boundaries did not affect the primitive artists After a brief introduction, there follow short accounts of nearly three hundred sites where drawings occur These are largely based on materials (now in the care of the Department of Anthropology at the University) which were generally the contributions of private individuals The author has, however, studied a number of sites himself and his work is far from being purely one of compilation Next an analysis of the art is given, and the various types of figures to be found are duly classified Distribution maps show that while certain types of figures occur throughout the area, others occupy a more limited field The paintings, it appears, are almost entirely confined to the south west of the area under discussion

This analysis probably makes the most interesting reading in the whole volume The human form is represented again and again, and many of the conventions and symbols used in similar art groups in the Old World are to be observed here too Naturally, this does not necessitate any cultural connexion between, say, the Copper Age artists of southern Spain and these American draughtsmen of a probably very different date But it is interesting to note in the New World a similar desire to symbolise and, resulting therefrom, the occurrence of very similar symbols This is not difficult to explain, however, for conventionalisation in the sense in which we are using the word means the selection and emphasis of certain salient features in the object to be represented and the suppression of all unessential details For example, in the much older Upper Palæolithic art, conventionalisation also occurs, and such an object as a horse's head, seen 'full face', is represented as a trident like figure—to such an extent has the dropping out of detail reduced the picture—and we are left with two ears and the mane (the central prong of the trident) and length ! It is therefore not unnatural to find that, given the desire to conventionalise the figure of a man, certain types of symbols appear in widely separated parts of the world After all, there are only a limited number of symbol forms to which the human shape can be reduced when treated in the manner just described

The author hesitates to regard some of the symbols figured on p 184 as being human form derivations, but many of them can be matched in the Copper Age art group of Spain with figures which undoubtedly represent men and women Certain other figures were, he suggests, phallic symbols He may be right, but a simpler explanation would seem to be that they are merely drawings of human beings in which the sex is indicated Every Greek statue is not a phallic representation because the sex is obvious The animals are, of course, more difficult to 're naturalise', but some of the species indicated—including sheep—can be recognised

The geometric patterns include zigzags, concentric circles, spirals, etc These are of an especial interest, though once again correlations with similar figures in art groups in far off parts of the world are rash and unwarranted—the number of *simple* geometric designs conceivable being very limited In any case, however, the Spanish and North African counterparts of these geometric designs show differences which were not so apparent when we were considering the conventionalisations from life

The author next considers the meaning of the art and its age As regards the former, he rejects the notion that the drawings were purely decorative in intent, or executed to while away a chance half hour They are often found far away from settlement sites, and the Indians to-day, though professing to know nothing about them, nevertheless regard them with awe On the whole, he seems to consider that they were connected with initiation ceremonies which take place at the age of puberty among many primitive peoples The question of the age of the drawings cannot be answered with any certainty Most of them probably date from the Basket Maker to the Cliff Dweller or early Pueblo culture The drawings of the Santa Barbara district (where many of the paintings are situated) have, however, a very fresh appearance and would seem to be the most recent in origin

In conclusion, there are no less than 94 half tone plates It is perhaps a pity that the carvings were almost invariably chalked before being photographed The process of chalking is in general to be avoided for scientific purposes, since it allows the personal factor to come into the work Rock carvings will almost always photograph well at those times of day when the sun's rays strike the figures obliquely, and a certain proportion of such photographs would have been very welcome in this volume Altogether, however, this is a really excellent work, which should not be missed by students of American archæology or primitive art

M C BURKITT

The Geology of Great Britain

Handbook of the Geology of Great Britain a Compilative Work Edited by Dr J W Evans and Dr C J Stubblefield Pp xii + 556 (London Thomas Murby and Co, 1929) 24s net

THIS handbook is a new and enlarged edition of the volume dealing with the British Isles of the "Handbuch der regionalen Geologie", published in Heidelberg about twelve years ago The general plan of the work is the same as that followed in the German issue with the exception that Ireland is no longer included The chapter devoted to the geology of the Channel Islands is retained Seventeen geologists, all authorities on the particular subjects with which they deal, have contributed, and the task of editing the manuscripts must have entailed much labour, but the book makes a notable advance on the earlier volume, and the editors are to be congratulated on the successful completion of their work

As was to be expected from the names of the contributors, the chapters devoted to the description of the Pre Cambrian and Lower Palæozoic rocks are excellent summaries of the knowledge now possessed of these formations A few minor discrepancies, however, may be noted in reading the accounts, but their presence in no wise seriously affects the subject matter For example, readers would be enlightened if the phrase "the term Caledonian has come into use in Goodchild's sense" (p 31) were explained One reads later (p 142) that Goodchild used the term for a stratigraphical unit, whilst earlier (p 2) one finds the more familiar use of the term to denote a system of folding Again, some confusion is created by the use of the term 'southern Scotland' for southern Highlands (p 33), more particularly since an unknown outcrop of Dalradian in Devonian is shown on the map (p 37) as occurring somewhere near Lanark Less important is the statement that E B Bailey accepts the Moine gneiss as altered Torridonian rocks

The difficulty of keeping abreast with geological literature is probably responsible for the absence of any reference to the occurrence of rocks of Lingula Flags age in a borehole in Essex, and to the discovery of the pygidium of a trilobite (*Calymene* sp) in the Stiperstones Quartzite The specimen is now preserved in the Museum of Practical Geology, and an announcement of its presentation was made in 1918

It would seem that much further study is necessary before the classification of the rocks grouped under Downtonian is finally decided In the Silurian chapter, an excellent summary of the previous investigations is given under the heading Downtonian, with the provision that it is as yet premature to decide whether the rocks should be regarded as belonging to the lower part of the Devonian system or retained as the upper members of the Silurian In the brief description of the Downtonian in the Devonian chapter, however, we read that the Downtonian "may be considered to represent a passage from the Silurian to the Old Red Sandstone" (p 138) It is perhaps not necessary to make further comment on this question of classification at the moment, but my own experience of these beds on the Welsh borderland lends support to the view that the Ludlow Bone Bed forms a natural base to the Devonian System, as advocated by Dudley Stamp and other workers

By far the most notable contribution to the volume is that made on the Lower Carboniferous rocks It is concise, lucid, and informative, and

the author, besides incorporating a considerable amount of original work, has shown great skill in marshalling the results attained in England by many workers inspired by the earlier researches of Vaughan and Garwood. Geologists, both in England and Scotland, would, however, have welcomed a more up to date account of the Scottish Lower Carboniferous rocks. Much work has been done in Scotland since 1910, and there is, in consequence, a considerable body of palæontological evidence now available to permit a close correlation to be made with the corresponding rocks in England, despite the statement that an application of zonal methods to the Scottish Carboniferous is not possible (p. 224). There is every reason to hope that further study of the Calciferous Sandstone series of Fife and the Lothians will yield useful guide fossils, and the reviewer thinks it probable that the Rhynchonellids found by Kirkby in Bed VII., a limestone lying about 3350 feet below the Hurlet at Randerstone, St. Andrews, may represent the horizon of *Camarotœchia proava*. It is not without significance that algal remains are abundant about 100 feet lower in the sequence, particularly in Bed IX.

Respecting the Upper Carboniferous rocks, the succinct account of the Millstone Grit is equally valuable in presenting in summarised form the researches of Bisat and those of W. B. Wright and his colleagues. The zonal studies of *Goniatites*, initiated in Great Britain by Bisat, have already borne fruit in elucidating the somewhat complicated stratigraphical relations within the formation. The account of the Coal Measures is somehow less satisfactory. Although the chapter is a veritable store of information, it lacks the precision of other contributions. This is perhaps due to the absence of sections illustrative of the succession in each of the principal coalfields. The author makes full reference to the zonal work of Kidston, Arber, and Crookall on the palæobotanical side, and to the studies of Trueman, Davies, and Miss Dix, which have built up a sound scheme of classification based on the fresh-water Mollusca. No notice is made of the fact that the Mansfield marine band is a horizon that has been recognised in Scotland, Wales, and in other English coalfields outside Yorkshire and Nottingham. It may be of general interest to add that the great series of barren red measures in Ayrshire have recently yielded palæontological evidence which proves the presence of rocks of the Radstockian stage in this coalfield.

The rocks grouped under the Permian, Triassic, and Rhætic receive adequate treatment from their exponents. The writer of the Permian chapter has wisely avoided controversy by stating the connotation of the term Permian as used in his account. That there is a great need for further investigation of the Permian and Triassic strata in Great Britain is clearly revealed throughout the chapters. Thus, on p. 312 we are told that in the district of Mauchline "a volcanic group of strongly alkaline character" is associated with red sandstones, assigned by some authors to the Permian and by others to the uppermost part of the Coal Measures, whilst on p. 335, under the heading of Trias, the same sandstones are referred to the Permo-Trias. These difficulties serve to emphasise the important fact that, without the aid of sound palæontological data, little reliance can be placed on lithological characters as a means of correlation.

In the Rhætic chapter the customary clear diction of the author seems to have forsaken him in writing the second sentence on p. 341. It is so long and involved as completely to obscure its meaning.

The Jurassic rocks are dealt with in a more extended manner than was possible in the first edition, and the zonal succession established in the various groups by the studies of various workers, notably the late S. S. Buckman, the Nestor of British palæontologists, is set forth on four correlation tables. Despite the small discrepancies which may be corrected before re-issue, the tables will prove a boon to students. Readers would be helped, however, if the English divisions were placed in a column to show their approximately equivalent stages, and so avoid the need to make reference to p. 361 where they are tabulated. One is surprised to read that the mutual relations of the Hartwell Clay are still uncertain. The chapters on the Cretaceous and Tertiary rocks are beyond reproach and deserve praise.

Considerable portions of the account of the phenomena associated with the glaciation of Britain taken from the first edition have been incorporated in the present volume; but the contributors have brought to bear on the subject a wide experience and knowledge gained in Great Britain and other countries. This is particularly well shown in the description of glacially disturbed deposits and in the discussion of glacial tectonics. The views expounded will be new to many readers who have not had access to the authors' papers.

In spite of the comprehensive way the subject has been dealt with, notable work in some areas has been entirely overlooked. London geologists, for example, will search in vain for any reference

to Lake Oxford and the Goring Gap The admirable investigations of Dr Sandford in the Oxford district are not mentioned in the chapter, although a full account of his studies has been given in the Oxford memoir issued by the Geological Survey in 1926 Again, the fine work of Dr Bremner on the glacial deposits of the north east of Scotland is passed over, as is also the results of a gravitational survey over the buried Kelvin Valley at Drumry, an account of which was read at the Glasgow meeting of the British Association In the latter instance it is possible that the chapter may have been set up in type at the time

The descriptions of the igneous rocks in the Ordovician and later formations are much the same as appeared in the first edition, but the author has in some cases availed himself of recent work to bring his account up to date

Valuable features of the volume are the correlation tables appearing in most sections and the bibliography appended at the end of each chapter While the lists of works given are not claimed to be complete, they have been compiled with care and will be of great service to all workers There is an excellent index containing more than 5000 entries J PRINGLE

The Parachor

The Parachor and Valency By Dr Samuel Sugden (Twentieth Century Chemistry Series) Pp vii + 224 (London George Routledge and Sons, Ltd , 1929) 12*s* 6*d* net

IN 1923 a short paper by McLeod was published in the *Transactions of the Faraday Society*, in which a simple relation between density and surface tension was disclosed, namely

$$\gamma = C\,(D-d)^4$$

where γ is the surface tension of a liquid, whilst D and d are the densities of the liquid and of its saturated vapour at the same temperature The significance of this formula was that the influence of temperature on surface tension was now represented in a rational way, since the surface tension was made to vanish at the critical point, when the densities of the liquid and of its saturated vapour become identical, whereas the formula of Ramsay and Shields, in which the density of the vapour was ignored, makes the surface tension vanish 6° after the critical temperature is reached

Up to this point the surface tension plays the leading rôle, but the author of the present volume discovered a much more far-reaching application of McLeod's formula Thus, if the surface tension γ divided by $(D-d)^4$ is a constant, it follows at once that $(D-d)$ must be a constant if divided by $\gamma^{\frac{1}{4}}$, in other words, the influence of temperature on specific and molecular volumes can be eliminated completely if D is replaced by $D-d$ and then divided by $\gamma^{\frac{1}{4}}$ The function $M\gamma^{\frac{1}{4}}/(D-d)$, which Sugden calls the parachor, is in fact a molecular volume, M/D, which has been corrected with the help of the surface tension for the overwhelming influence of an internal pressure ranging in typical cases from 1500 to 60,000 atmospheres, and is thus made independent of the temperatures at which it is measured It therefore replaces, with greatly enhanced efficiency, the old molecular volumes, which Kopp attempted in vain to regularise by measuring them at the boiling point of each liquid instead of at the atmospheric temperature These old molecular volumes made only a feeble pretence at being additive functions, since different atomic volumes had to be assumed for oxygen in alcohols, ethers, ketones, etc , but the molecular parachors need only a single atomic parachor for each kind of atom, and a single constant each for the double and triple bond, or for the formation of a ring of *n* atoms, whatever the nature of the atoms which are joined by the multiple bonds or included in the ring It is, indeed, entirely pleasing to encounter a function which vindicates forthwith the Kekulé formula for benzene, even though it admits the existence of an unexplained anomaly in the carboxyl group

The present writer has a peculiar reason for thinking well of the parachor, since it provided the first experimental verification of his contention that a double bond need not always be a double covalence or a double electrovalence, but may sometimes be 'mixed' (or 'semi polar' as Sugden has called it), consisting of a covalence and electrovalence superposed on one another This vindication was particularly welcome in view of the fact that the first paper on the subject had the honour of being consigned to the archives of the society to which it was sent, although the Faraday Society found no difficulty in giving publicity to the 'mixed double bond' as a legitimate extension of J J Thomson's theory of 'intramolecular ionisation' The even more conclusive proof which resulted from the resolution of semi-polar compounds into optically active components, and the further evidence derived from Dr Bennett's fascinating studies of stereoisomerism, are set out fully in the volume now under review

Whilst the discrimination of double bonds, as being either nonpolar or semi-polar, was the first

and perhaps the most important experimental achievement of the parachor, this function is capable of such a wide range of applications that most of the outstanding valency problems in chemistry provoke at once a question as to the verdict which will be given when data from the parachor become available In some cases the strictly additive character of the parachor precludes the possibility of an answer Thus it makes no difference to the parachor whether two double bonds are 'conjugated', with one single bond between them, or are more widely separated in the molecule, since there is no echo here of the anomalies which are called to mind by the phrase 'optical exaltation', moreover, the conversion of two double bonds into one triple bond makes no difference to the parachor, so that equal values are given by systems such as $CH_3O\ C{\equiv}N$ and $CH_3N{=}C{=}O$ There are, however, many cases in which the formation of a ring in place of a double bond can be detected, and the later studies of Sugden and his colleagues have revealed an array of positive and negative anomalies which is amply sufficient to keep the parachor in the limelight for many years to come

Sugden himself has found an explanation of several large and important groups of negative anomalies by calling to life the single electron bond, which has proved so attractive to students of 'partial valencies' ever since G N Lewis declared that it takes two electrons to make a bond Lewis's contention appears even more convincing at the present time, when physicists have explained that pairs of electrons spinning in opposite directions are required to form a stable electronic system in molecules as well as in atoms or ions, but Sugden has worked out a series of formulæ which are at least consistent with one another and with certain postulates as to the parachor value to be assigned to this hypothetical type of linking

Whilst, therefore, both chemists and physicists may look with dislike on odd electron bonds, it must be admitted that all the alternatives which have yet been devised have been turned down as a result of the experimental work which the author has carried out in order to test them Unbelievers can, therefore, only take refuge (like the reviewer) in a barren agnosticism, hoping that a function which cannot distinguish between one triple and two double bonds may have failed equally to discriminate between a pair of single-electron bonds and some more plausible electronic configuration

Here and there the author is perhaps too confident in his statements Thus, it is not true that diborane, B_2H_6, "contains only twelve electrons" (p 95) and that therefore "the presence of singlet linkages must be admitted" (p 130), when there are really 10 K electrons and 6 L electrons available for joining the 8 atoms, and it is only when certain postulates have been accepted, and the possibility of alternative interpretations has been finally denied, that it can be admitted, in the case of basic beryllium acetate, that "the parachor shows conclusively that the singlet formula is correct" (p 146) Phrases such as these are, however, not easily avoided when describing the results of a battle in which present victory has been won, and the risk of retreat in the future is still too remote to justify the qualifications and reservations which would appear necessary in less favourable circumstances

If Dr Sugden had merely collected his published work into a monograph, and discussed its implications in greater detail than is usually possible in original papers, he would have rendered a very useful service both to his colleagues and to their more advanced students He has, however, done much more than this, since the volume now under consideration also contains chapters on "The Liquid State", on 'Associated Liquids", on "Atoms and Spectra', and finally on "The Quantum Theory of Shared Electrons" These are written in the masterly manner of one whose knowledge comes from original sources, and has not been distorted by transmission through intermediate text books For this reason the book can be commended to advanced students who are not specially interested in the parachor, but who would like to keep abreast with modern research in atomic physics Moreover, even the earliest references appear to have been consulted in the original, with the result that the foundations of our modern conceptions are sometimes unexpectedly laid bare The book is, in fact, exceptionally well filled with information, even for a hardened reader of physico chemical literature, and familiar facts and theories are often revealed in an unfamiliar light, and with unwonted clearness On the other hand, the indices and subscripts are printed in such small type that they are often defective or illegible The rather bewildering electronic formulæ which the author has adopted have also given a lot of trouble to the printer, whose symbol for benzene is a very battered hexagon It is also curious that, although the symbol for the parachor is given in the first instance on p 30 as [P], it is nearly always printed afterwards with a superfluous (and unintended?) full stop inside the bracket

In conclusion, since the book deals at length with the methods of determining surface tension, it is difficult to resist the temptation to bring together two phrases in reference to the method of deducing tension from the weight or volume of falling drops "Iredale has criticised the formula used by Harkins and his co workers, and suggests a return to an equation given earlier by Worthington" Nevertheless, "the equations of Harkins and Worthington are really identical, for one can be deduced from the other without introducing any approximations" T M LOWRY

Unofficial Pharmacopeias

(1) *The Extra Pharmacopœia of Martindale and Westcott* Revised by Dr W Harrison Martindale Nineteenth edition In 2 volumes Vol 2 Pp xxxviii + 759 (London H K Lewis and Co, Ltd, 1929) 22*s* 6*d* net

(2) *Pharmaceutical Formulas* P F Vol 1 being *The Chemist and Druggist* Book of selected Formulas from the British, United States, and other Pharmacopœias, together with Non Official Formulas from various Sources Tenth edition, entirely revised and rewritten By S W Woolley and G P Forrester Pp xvi + 1146 (London *The Chemist and Druggist*, 1929) 15*s*

THE last British Pharmacopeia was published in 1914, a new one is now in preparation and is due to appear in 1931 In the interval, the United States has produced two official pharmacopeias, the ninth in 1916 and the tenth in 1926 The long intervals between successive editions, the wise conservatism of pharmacopeial commissions, and the limitations imposed upon pharmacopeias by their legal status, make it inevitable that there must always be a huge materia medica which does not find official recognition, and this is the happy hunting ground of the compiler of dispensatories, formularies, pharmacopeial companions, and in general of the mass of literature which may be grouped together as 'unofficial pharmacopeias' Such literature is indispensable to the busy pharmacist and medical man, as is evident from the fact that the two books now under review are in their nineteenth and tenth editions respectively They both supplement the official pharmacopeia and they are complementary to each other

(1) The "Extra Pharmacopœia" of Martindale began as a modest pocket volume of 300 pages in 1883, and is now issued in two volumes of 1207 and 759 pages respectively, and even this increase in size is not sufficient to include all that the author would like to put into it, for he is now finding it necessary to refer the reader back to information given in previous editions but omitted from this one The two features which have contributed more than anything else to the popularity of the book are the author's gift of compressing the contents of a paper into a few lines or a few words, and his conscientious industry in searching the literature and providing the reader with references to papers or abstracts in readily accessible journals The division into two volumes took place in 1912, and since then Vol 2 has been a compact manual of chemistry designed to meet the everyday needs of the pharmacist and the medical man These needs are very varied, and consequently the volume deals with such subjects as indicators for volumetric analysis, the analytical recognition of organic substances used in medicine, water analysis, embalming, composition of proprietary medicines, mould inhibition by preservatives, etc The author is one of those fortunate people who is not hypnotised either by authority or the printed word, and his remarks on some fashionable doctrines and processes are shrewd, sometimes piquant, and invariably tinctured by a genial conservatism Like all editions of this work, this edition is remarkably free from errors and is well up to-date

(2) "Pharmaceutical Formulas" is a book of entirely different type, being almost wholly concerned with the compounding of drugs, a subject with which readers of NATURE probably do not desire to extend their acquaintance beyond that casual and involuntary knowledge forced upon them by occasional illness The real public service rendered by the issue of a book like this may perhaps be illustrated by reference to such a substance as acriflavine Most organic chemists are aware that the discovery of this material marked a distinct advance in chemotherapy, but few realise that its practical use in medicine depends upon the exercise by the pharmacist of his art, so that it may be presented to the medical man in a form suitable for application In this volume five preparations of acriflavine—solution, lotion, emulsion, paste, and poultice—are described, and from them the busy practitioner can select the form best suited for any particular case The book gives the same kind of information for each and all of the hundreds of materials which modern science has placed at the service of medicine

A pleasant feature of the volume is its insistence upon the historical aspect of the pharmacist's art and the brief but wholly delightful note upon 'honey water' which George Nelson, author of

"The Compleat Course of Chymistry", compounded for King James II is an example of how such things should be written It is a little surprising to find that "Confectio Damocratis", invented by Mithridates the Great, 134 B C, may still figure in modern medicine It is an ingredient of the original 'Warburg's tincture', a mixture still used by some European residents in the tropics, and it may be regarded as the real ancestor of the aromatic confection invented by no less a person than Sir Walter Raleigh, and which in a modified form is still official in the last edition of the British Pharmacopeia T A H

Birds and their Ways

(1) *The Cowbirds a Study in the Biology of Social Parasitism* By Dr Herbert Friedmann Pp xvii + 421 (Springfield, Ill, and Baltimore, Md Charles C Thomas, London Baillière, Tindall and Cox, 1929) 27*s* net

(2) *Birds and Green Places a Book of Australian Nature Gossip* By Alec H Chisholm Pp xiv + 224 + 50 plates (London and Toronto J M Dent and Sons, Ltd, New York E P Dutton and Co, Inc, 1929) 15*s* net

(3) *The Birds of South East Devon being a List of those Species known to visit that part of the County including and lying to the East of the Exe Valley* By Lewis R W Loyd Pp 176 + 6 plates (London H F and G Witherby, 1929) 10*s* 6*d* net

(4) *The Birds of Ayrshire* By E Richmond Paton and Oliver G Pike Pp xxi + 228 + 25 plates (London H F and G Witherby, 1929) 21*s* net

(1) THAT form of parasitism which is familiarly exemplified by the common cuckoo in Europe, and by some other members of its family found in Europe, Asia, and Africa, occurs also among the cowbirds of the New World, among the weaver birds and the honey guides of Africa, and in one South American species of duck As it doubtless originated separately in each of these diverse groups, it constitutes a very remarkable instance of parallel evolution Next to the cuckoos, the cowbirds are the best known of the groups, and Dr Friedmann's important monograph brings together the existing information as to their reproductive habits, and adds to it the results of his own intensive observations

The cowbirds belong to the family of hangnests, closely allied to the finches There are seven species, in three genera, and six of these belong either to South or Central America the remaining species is widely distributed in the northern continent Two of the species are rarities known only from a few specimens, but the habits of the other five present material for an interesting comparative study

The bay winged cowbird of South America is parasitic only in that it lays in other birds' nests, taken by force or found disused If necessary, moreover, it builds for itself, and in any case it incubates its eggs and rears its young in quite a normal manner The screaming cowbird is truly parasitic, but its sole victim is the preceding species! More than one egg may be laid in the same nest, and there is no removal of eggs of the rightful owner The shiny cowbird, widely distributed over South America, victimises many species, but its parasitic habit is poorly developed and somewhat haphazard in its operation Very many eggs are laid, and of these the majority are wasted the eggs of the victims are frequently destroyed, but so also are eggs of its own species on occasion, so that this cowbird itself exercises a check upon its increase in any locality The North American cowbird has the parasitic habit better developed and lays a small number of eggs to good purpose the species which it has been known to victimise number a hundred and fifty eight, and individual birds, unlike cuckoos, show no very definite specificity in their choice of victims The red eyed cowbird of Central America is parasitic upon a limited number of species The rice grackle, a close ally of the true cowbirds, is also parasitic

As with our common cuckoo, the young cowbird usually survives at the expense of the offspring of its foster parents These are not ejected but are trampled or starved to death in the struggle for food Young screaming cowbirds, however, live in amity with the young baywings belonging to the nest this is paralleled in the Old World by the case of the great spotted cuckoo and the magpie

Dr Friedmann's monograph is a mine of information on the reproductive habits of cowbirds, but it is not a very readable book except for the serious student A more adequate general survey, summarising the systematic accounts of the several species, would have added greatly to its value, and the brief final chapter discussing the evolution of parasitism might well have been amplified There are some curious mistakes, as in the naming of the races of the North American species on page 152, and in the description of the diagram on page 263

(2) Mr Chisholm's book is of a very different type It is frankly a collection of 'Nature gossip'

rather than a contribution to science, but the author has the advantage of dealing with an avifauna of which little of a popular kind has been written, that of Queensland, and he describes the habits of many strange and wonderful birds which the reader in Great Britain knows, at most, only from captive or museum specimens Mobs of emus running on the great plains, the curious bee like swarming of the wood swallows, the rare paradise parrot nesting in termites' mounds, the cradle nest of the fairy warbler, the truly extraordinary habits of the bower birds these are among the subjects on which Mr Chisholm discourses pleasantly, weaving his account of the birds into the story of his personal experiences in search of them

(3 and 4) The remaining two books on our list come within the category of district avifaunas Works of this type fulfil two functions in the first place, they are of local interest, and, in the second, they provide valuable material for the compilers of books on the birds of the country as a whole Neither of these works comes up to the very highest standard for this class, but both are competent and useful contributions Mr Loyd is at a disadvantage in dealing with an area of which the limits are not recognised, and he does not always observe them himself He also encumbers his accounts of the local status of each species with brief general remarks which are inadequate for any purpose and irrelevant to the special object in view The work of Messrs Paton and Pike contains some very beautiful photographs of birds, although here again relevance may be questioned

Evelyn's "Fumifugium"

Fumifugium By John Evelyn, of Balliol College, Oxford, in 1661 Now reissued as an Old Ashmolean Reprint in the Year of the refacing of the Old Ashmolean Museum, which, like 'Fumifugium', was dedicated to King Charles II, founder of the Royal Society Pp viii + 49 (Oxford Dr R T Gunther, Folly Bridge, 1930) *2s 6d*

VOCAL as have been the protests against the emission of smoke and fumes from the chimneys of electric power stations in London, when one reads No 8 of Old Ashmolean Reprints, the "Fumifugium" of John Evelyn (1661), these modern protests seem couched in language mild and restrained compared with the diarist's wealth of obloquy and sustained invective against the effects of burning of coal by brewers, dyers, lime-burners, soap- and salt-boilers, and other private traders Additional picturesqueness is obtained, not by the modern method of pictures showing the pall of smoke over our cities or the corrosion of stonework, but by lurid quotations from the classics to heighten the condemnation of "that Hellish and dismal Cloud of Sea Coale" with its "fuliginous and filthy vapour, corrupting the Lungs", causing the City of London to resemble rather the "Suburbs of Hell than an Assembly of Rational Creatures and the Imperial Seat of our incomparable Monarch" Truly John Evelyn was a man before his time, and his "Fumifugium" characteristically not only describes the grievance, but also indicates the remedy and suggests an amelioration

Writing so soon after the Restoration, Evelyn philosophises on the effects of pure air, contrasting the proneness to rebellion of northern nations, with the more constant and steady temper of the inhabitants of lands nearer the tropics His commendation of air "which is cleare, open, sweetly ventilated and put into motion with gentle gales and breezes" would meet with the approval of Prof Leonard Hill On the other hand, he recognises that while the effects of ill conditioned meat may be mitigated by cooking, poisoned air insinuates itself into the vital parts immediately An eclipse, he declares, darkens the attributes of the otherwise incomparable City of London, on the situation and advantages of which he writes a fine panegyric, and this, not from the "Culinary fires", but from the "Tunnels and Issues" of the aforesaid traders giving off "that pernicious smoake which sullies all her glory superinducing a sooty Crust or Furr upon all that it lights, spoyling the moveables, tarnishing the Plate, gildings, and Furniture and corroding the very Iron bars and hardest Stones with those piercing and acrimonious Spirits which accompany its Sulphure" Further, it kills flowers, fruit, and bees, so that they can no longer thrive in the neighbourhood of the Strand, unless on such occasion as when coals were scarce by reason of the blockade of Newcastle in 1644

Worst of all, those who repair to London become immediately afflicted with divers ailments of which detailed and picturesque description is given "For is there under Heaven such Coughing and Snuffing to be heard, as in the London Churches and Assemblies of People, where the Barking and the Spitting is incessant and most importunate?" In the current of his invective, Evelyn is carried

somewhat to overstate his case when he affirms, "that it is not the Dust and Ordure which is daily cast out of their Houses but this continual Smoake, which renders the Streets of London dirty even to a Proverb"

In Part 2, Evelyn suggests the removal to a competent distance of factories giving off this evil smoke, a remedy which, however suitable to his time, would not be a solution in ours, when to domestic chimneys is attributed at least half of the smoke nuisance His selection of a site five or six miles distant from London "below the River of Thames" and apparently east of Blackheath, having regard to the prevailing winds and to water transport, is reminiscent of a phase in the present controversy Not only, however, should the smoking factories be removed, but he would also have banished churchyards, slaughter houses, gaols, chandlers', fishmongers', and butchers' yards to some place farther off, to prevent their distempering the air breathed by the inhabitants While these opinions leave no doubt as to Evelyn's fitness for his post of commissioner for improving the streets and buildings of London, it is to be feared that the opportunity afforded by the Great Fire was not seized on to give effect to his views and to Wren's ideas of town planning in the reconstruction necessary after that event

As might be anticipated in one so fond of gardening, Evelyn's scheme for "Melioration of the Aer of London" is "by Way of Plantations" In all low lying grounds near the city, and especially towards the east and south west, he suggests the plantation of belts of trees, lined with fragrant shrubs, while the spaces between the trees would be used as borders filled with sweet smelling flowers It is a pleasure even to read the list of these fragrant plants, and to conceive a London so small as to warrant his hope that "the whole City would be sensible of the sweet and ravishing varieties of the perfumes"

If Evelyn should return to day as First Commissioner of Works, what would he find in the conditions of the colossal city London has in the meantime become? Still the only partially solved smoke problem of the innumerable domestic fires, but let us hope soon the suppression of smoke and acids from the chimneys of large installations consuming coal, an increasingly healthy city through improved sanitation, rather than diminution of smoke, while perhaps the large area still given up to open spaces and parks would in some measure satisfy the author of "Sylva" and the "Compleat Gardener" R R

Hydrogen Ion Concentration

Hydrogen Ions their Determination and Importance in Pure and Industrial Chemistry By Dr Hubert T S Britton (Monographs on Applied Chemistry, Vol 3) Pp xiv+515 (London Chapman and Hall, Ltd, 1929) 25s net

THE introduction of the osmotic and electrolytic dissociation theories of solutions initiated, as is well known, a new era in the development of chemistry, and the new direction which was thereby given to the interpretation of chemical processes taking place in aqueous solution soon made itself powerfully felt also in the various branches of biological science and in the study of colloids The influence of different salts on colloidal matter and on the living cells of plants and animals became the subject of extensive and intensive investigation, and it was found that many of the observed phenomena could best be interpreted as due to the specific action of ions

Although it was to the action of the ions of salts that attention was at first mainly directed, it came to be recognised later that a position of special importance must be assigned to the hydrogen ion, and at the present day the 'acidity' of the medium is known to exercise a profound influence in operations and processes of the most diverse kind In volumetric and gravimetric analysis, in the precipitation of metal hydroxides, in soil analysis, in bacteriology, and in many industrial operations, the concentration of hydrogen ion is a factor of fundamental importance The determination and control of the concentration of hydrogen ion in a solution has, in consequence, received a rapidly increasing measure of attention in recent years In view of the important part played by hydrogen ion concentration and of the widespread necessity of obtaining a knowledge of the methods of determining and controlling the concentration of hydrogen ion, the present work by an author so competent and well qualified as is Dr Britton, is sure of a very hearty welcome

In the opening chapter, the author sets forth the theory of the electrometric methods of determining the concentration of hydrogen ion and adopts the ion concentration rather than the activity theory in the interpretation of electrode potentials The decision of the author in this respect has doubtless much to commend it in view of the public for which the book appears to have been written, but even a short discussion of the relation between the ion-concentration and the activity theories would have given an additional

value to the book Following on the discussion of the theory of electrode potentials there comes a description of the different kinds of electrode, and workers will find the author's account of the use of the quinhydrone and glass electrodes of particular interest and value The latter electrode, especially, is probably not so well known as it should be

In the succeeding chapters the author gives a very full, clear, and, on the whole, satisfying exposition of the practical applications of the electrometric and colorimetric methods of determining the concentration of hydrogen ion in solution, and points out the importance of such determinations in analytical chemistry, in the industries of tanning, brewing, baking, dyeing, etc, in the manufacture of paper, and in the refining of sugar The rôle of the hydrogen ion concentration in connexion with the purification of water, sewage disposal, and the fertility of soils, is also clearly discussed

In the volume before us, the third of the admirable series of monographs edited by Dr Howard Tripp, the author maintains the high standard of excellence set by the preceding volumes, and the work is remarkably free from printers' and other errors The book deserves to be, and doubtless will be, widely read, not only by advanced students of chemistry but also by those who are interested in the many and varied branches of science and industry in which the concentration of hydrogen ion plays a vitally important part A F

The Mechanical State of the Future

The Conquest of Thought by Invention in the Mechanical State of the Future By H Stafford Hatfield (Psyche Miniatures General Series No 26) Pp 117 (London Kegan Paul and Co, Ltd, 1929) 2*s* 6*d* net

A GREAT deal of thought is being concentrated to day on the general aspects, the underlying principles, and the probable future of our civilisation, which is supposed to be distinguished from all previous civilisations by a dominating industrialism gradually extending and deepening its hold throughout the entire social organism until it is complete master thereof, holding it under grievous thraldom, body and soul The present small volume, one of the Psyche miniatures now being published by Messrs Kegan Paul, attempts to show that this domination will take the form of a perfectly mechanised State in which practically every function and activity of the individual citizen will be a matter of regulated routine, and all his actions will be so guided and prescribed by the State that he will have little or no initiative or volition of his own, he will become a semi-hypnotised automaton, a machine slave The Machine Age will have arrived, not only in a literal sense wherein every part of manufacture will be done by machinery, but also in a wider and more figurative sense, wherein the machinery of government, of municipal organisation, and of industrial organisation will be so perfected that every circumstance or condition of the individual citizen will have its appropriate formula, and all that he will have to do to achieve a wholly successful life will be to apply formulæ as and when required, and with a minimum of conscious thought, effort, or mental disturbance of any kind Thought will have been conquered by invention

This is surely a strange paradox, an apparent contradiction in terms if, as one seems justified in assuming, invention is among the highest forms of thought, but what Dr Hatfield probably had in mind was the ultimate domination of society by extreme mechanisation based on invention, so that thought might almost seem to become superfluous, and he was probably looking about for a startling or impressive formula for expressing such a possibility But his definition of invention is not altogether satisfactory, he says

"The word invention is intended to cover the whole of the means by which humanity makes use of accumulated knowledge to eliminate the chances and difficulties of coping with the external world and to render it more agreeable"

This excludes a considerable field of invention which does not, directly or indirectly, aim at making the world more agreeable, and includes also a vast amount of invention which the author himself is perhaps contemplating under his definition, but which, instead of making the world more agreeable, has had precisely the contrary effect It may be, however, that the great majority of people would like to be relieved of all responsibility, to have nothing to do but obey rules and regulations, to lead a perfectly safe life sheltered from all the perversities of fortune or misfortune, to become volitionless automata But whether this is the best and highest and noblest destiny of the human race is another matter It is true that Dr Hatfield has made provision for original thought, scientific research and speculation, and original creative work of all kinds, in special segregated institutions, altogether apart from the common herd, and yet it may be questioned if this is quite the best consummation for science itself to aim at

However, it is only fair to say that the author is not speaking of the 'best', but the inevitable

On psychological grounds, possibly a plausible case might be made out for predicting some such culmination for our civilisation as that which Dr Hatfield presents, but it is a hopeless and gloomy picture, an ignoble destiny indeed for the human race, and it does seem that sufficient account has not been taken of all the relative factors and of any possible ameliorative or preventive measures that could be suggested If one could only regard the book as a very clever and subtle satire, a brilliant caricature of what we are coming to, the outlook would be less hopeless, but the author appears to be in deadly earnest, and he concludes his highly interesting and thought provocative thesis with the assurance that "All this is happening, so it seems to me, in so inevitable a manner that any argument concerning its desirability appears futile" There is thus no more to be said W G L C

Witches, Vampires, and the Devil

(1) *Witch Hunting and Witch Trials the Indictments for Witchcraft from the Records of 1373 Assizes held for the Home Circuit A D 1559–1736* Collected and edited by C L'Estrange Ewen, with an Introduction Pp xiii + 345 + 7 plates (London Kegan Paul and Co, Ltd, 1929) 21s net

(2) *The Vampire in Europe* By Montague Summers Pp xii + 330 + 8 plates (London Kegan Paul and Co, Ltd, 1929) 15s net

(3) *The Devil an Historical, Critical and Medical Study* By Maurice Garçon and Jean Vinchon Translated by Stephen Haden Guest from the sixth French edition Pp 288 (London Victor Gollancz, Ltd, 1929) 12s 6d net

THESE three books on witchcraft and cognate matters afford an interesting contrast in method The first deals objectively with facts, and thereby adds much to our knowledge, the third analyses familiar material from an original point of view as a psychological study, while the second may enlarge the reader's ideas as to the extent of human credulity even in these days

(1) Mr Ewen's book is a mine of information for the student A patient examination of documents in the Record Office has resurrected a large number of cases never previously noted, either by Hutchinson or by other writers on witchcraft Prof Notestein's list of 100 cases in the home counties is swelled to five hundred individuals and seven hundred indictments To these is added an appendix containing a list of further cases mentioned in contemporary documents, but not in the records of the courts Mr Ewen has also provided his readers with a complete apparatus for the study of the subject

In his lengthy introduction to the abstracts of indictments which forms the main section of the book, Mr Ewen surveys the whole machinery of witchcraft persecution, including the legislation from the earliest times, the courts in which trials might be held, and the procedure from information to trial The abstracts themselves are a valuable survey of the essential features of English witchcraft, and of the ends which the witch was supposed to have in view It is interesting to note that one witch was accused of digging up the skull of a dead man, an allegation also made in the Lancashire witch trial of 1612 One point of significance to emerge is that, so far as the home counties are concerned, the witchcraft persecution reached its highest under Elizabeth, and not under the Commonwealth, as is usually stated, another is the exceptional prominence of Essex as the home of the witch

(2) In "The Vampire in Europe", Dr Summers follows up his previous volume on the vampire by a collection of relations arranged under countries It affords plentiful material for students of the supernatural, but the author has had to interpret the vampire belief rather liberally to bring some of his data within the bounds of his subject Outside eastern Europe there is practically no evidence of the real vampire In ancient Greece and Rome, and still more in England and Ireland, until the literary efforts of modern times, the cases noted by Dr Summers are those of ordinary ghosts, often malignant, rather than of vampires The place of the vampire was taken by the were wolf In this volume Dr Summers appears to have abandoned his earlier methods entirely and to accept all stories at their face value as evidence—even fiction !

(3) "The Devil" is a useful corrective to Dr Summers It is also an answer, on one hand, to those who regard witchcraft as a surviving primitive religion, and on the other, to those who dismiss the evidence as due to, vaguely, hysteria As regards the first point, the authors hold that, beyond a few very general ideas, there is little of primitive magic in the witchcraft doctrine, except in so far as Innocent VIII gathered up much popular folklore in his famous Bull Nor was the devil a primitive concept Many hold that the concept of the devil was built up by the medieval church, just as the whole of the machinery of the witchcraft organisation was evolved by the Inquisition and judges through the medium of their examinations, which

were directed to elicit certain information Belief in the devil, on the other hand, is no evidence of delusion either in medieval or modern times It is an article of faith in the Roman Church, and before the explanation of hysteria can be applied to the facts, the border line of delusion must be fixed

The cases studied in the medico legal section of the book throws light on many manifestations of occultism They should be studied in conjunction with some of the cases of vampirism quoted by Dr Summers It must, however, be urged that the authors have paid too little attention to the survival of a strong element of real primitive belief among the people Can we fix a limit to the extent they were prepared to go in putting it into operation ?

The Trend of Applied Optics

Applied Optics and Optical Design By Prof A E Conrady Part 1 Pp ix + 518 (London Oxford University Press, 1929) 50*s* net

APPLIED optics, once a languishing subject, has now largely emerged from the phase of semi stagnation on one hand, and exploitation on the other, in which the outbreak of the War found it, and this book, contrasted with the predecessors of its class, emphasises the decided present-day trend of the science In his endeavour to confine his attention to ' real optics ', Prof Conrady has been influenced by some well-known criticisms of Prof Silvanus Thompson What was known as ' geometrical optics ' has, indeed, in more recent years, barely held its own against its critics, for it had certainly encroached to an unjustifiable extent upon neighbouring fields, at a period when un scrutinised criteria and false generalisations entered largely into its practical application The optical designer, examining his problems by the aid of such imperfect theoretical means, saw as through a glass darkly, quite unperceiving the imperfect nature and inadequacy for his purposes of the methods currently adopted and the shadow of fact which they revealed In later years the working of an ampler conception of the subject has removed the old inconsistencies and indicated fresh avenues of considerable possible development of the older plain theory

Broadly speaking, Prof Conrady proceeds by the conservative adoption of a type of semi-analytical method independently developed, and aims at providing a text book suitable for the use of students of the subject, in whom some rudimentary preliminary knowledge can be assumed The book opens with a chapter on " Fundamental Equations ", in which some of the simple, first order geometrical properties of symmetrical optical systems are considered and the old familiar com puting formulæ for the tracing of an axial ray attributed to Bessel are given Some further account of the simple Gaussian theory is given afterwards in Chapter ix on the general theory The student who realises at the outset the import ance of a thorough knowledge of the correct manipulation of the instrument of numerical cal culation will find useful guidance in the various practical hints and examples

Chapters follow in which spherical and chromatic aberration are considered upon the basis of trigono metrical calculation and leading up to the design of simple forms of achromatic object glasses, approximate algebraical expressions for these aberrations to facilitate the preliminary design being deduced from the fundamental equations and graphical methods being employed to advantage The chapter on spherical aberration is followed by a discussion on the physical aspect of optical images from an elementary point of view and the foundation of a system of optical aberrational tolerances, based upon the so called ' Rayleigh limit ', is laid, in readiness for application in suc ceeding chapters

Up to this stage, the student must be supposed ignorant of the aberrations and circumstances affecting extra axial image formation, and the following three chapters are devoted to this sub ject, which is approached by way of an application and extension of the previous algebraical third order treatment of axial spherical aberration of ray intersections applied to single surfaces Expressions similar to the aberration sums of von Seidel are thus obtained and employed as the basis of discussion with application to practice, the case of a system of ' thin ' components being especially considered Keeping in sight the appropriate needs of students, Prof Conrady clearly distinguishes three " Fundamental Laws ", these being generalisations of practical importance drawn from the third order theory of oblique pencils Direct computational experience of oblique aberration is postponed to a much later stage, where formulæ are given for the tracing of an oblique beam through any given axially symmetrical system Here it is sought to fortify the method by taking advantage of the foregoing analytical work in the interpretation of the results of computation

For the purposes of this first part, the third order analytical treatment does not seem to offer any outstanding intrinsic advantages over the

available alternative systems, or to exemplify how the subject, although not allowed to "become drowned in a vast mass of complicated algebra", may be presented to the student with any gain in clarity and perspicuity While so much remains to be done in the subject, it is a most lamentable fact that even upon common ground there should be no trace of an underlying unity in treatment or even in the notation employed by different writers This is in striking contrast to other progressive branches of applied mathematics, and as a result thereof, talented energies attracted to the subject in the past have been largely expended merely in independently evolving, in special notations, fresh metamorphoses of essentially the same theory, which have for the most part entered upon the world still born, destined to remain buried in the obscurer recesses of literature

The general form of Prof Conrady's algebraical theory must accordingly be familiar to the average reader Considered more in detail, the formulation is of the class in which the third order aberrations are regarded as depending upon the trigonometrical data specifying the passage of rays within the paraxial region in analogy to the simple ray tracing scheme for finite aperture, it is distinguished throughout by a decided practical bias, and also, however, by a somewhat laboured notation, which, apart from being a source of printing errors, is an obstacle to thought and progress It would be premature, on account of the apparently complementary nature of the forthcoming Part 2, to judge from the general point of view as to the comparative merit and utility of the system put forward

In an appropriate chapter the sine theorem is developed by extension out of the theorem of Lagrange The method has some didactic advantages Convenient formulæ for subsequent practical application are derived and proper emphasis is laid upon their inherent limitations, but considering the purpose of the work, the method would seem to be appropriate rather as a practical supplementation of a deduction in closer correlation with the physical aspect The book concludes with a chapter on the design of ordinary eyepieces as a fitting sequel to the foregoing theory, which pertains largely to telescope objectives

The general impression that remains is that the book would be of proportionately greater value, having regard for its intended purpose and audience, if the matter dealt with had been considerably compressed, for the work cannot be regarded as succinct Some other features cannot fail to impress themselves There is a noticeable tendency to looseness of expression The references to historical or contemporary work are few and far between and are merely of a cursory nature Differing favourably from most previous books on this subject, the ultimate workshop production is retained steadily in sight as an important factor influencing the course of the theoretical design of optical work The 'memoranda' following each chapter form a useful feature, but do not amply serve their purpose The book, as such, is well got up and appears at a time when there is a need for just this class of work In the present state of the literature, Prof Conrady's work will certainly form a noteworthy contribution

Big Game Hunting and Collecting

Big Game Hunting and Collecting in East Africa, 1903–1926 By Kalmán Kittenberger Translated from Hungarian Pp xix + 348 + 127 plates (London Edward Arnold and Co, 1929) 25*s* net

NUMBERS of men, first class old sportsmen, have lived long years and shot many lions in the bush regions of Central Africa, but unfortunately few of them have ventured or been able to put down their experiences on paper As often as not it is the man with more imagination than experience who ventures into print Mr Kittenberger, however, is one of the few During ten years in the lion country, shooting and trapping wild animals almost continuously, he killed thirty or more lions, suffered one severe mauling, and has survived to set down his experiences in a book of more than usual interest, adding as it does to our knowledge of the habits of Africa's great game His account, occupying the first third of the book, of his many adventures with the so called "King of Beasts" is, we think, one of the best and least coloured that has been written In reading some of his descriptions of hunts and exciting incidents, one may almost smell the pungent odour of the great night prowler after meat

Besides the author's own nearly fatal mishap, one or other of his men on various occasions was mauled by a lion or tossed by a buffalo, he is, therefore, in a position to say exactly what happens on these occasions Many authors describing the charge of a lion seem unable to avoid mention of great bounds and a mighty spring In reality, whatever the action at the commencement of the approach to a man or standing animal—whether creeping, galloping, or bounding according to circumstances, with head down and tail stiffened—

the final charge, in the present writer's experience, which agrees more or less with the author's, is a very quick and terrible rush, ending in the lion standing up with the great fore limbs widely extended, claws exposed, and mouth open. All happens in a moment, in a cloud of dust if in dry weather, the fearful right or left sideways blow with the huge paw, which does all the damage, coming almost too swiftly for the eye to follow.

The author, who made four expeditions in eastern equatorial regions before being interned for the duration of the War, also recounts his experiences with elephants in Uganda, but his knowledge of the greatest of beasts is not equal to what it is of the lion and the plains fauna, and, moreover, in this section he suffers apparently at the hands of his interpreter, the book being a translation from the Hungarian. His chapters, which are profusely illustrated with his own photographs dealing with most of the bush fauna and the birds, are very good reading. His final chapter contains useful directions on hunting equipment and the treatment of trophies.

The author's main interests throughout have been apparently the capturing and rearing of young animals, at which he seems to have become an expert. The majority of his antelopes were caught by driving the herds into loop nets, hung in eight or ten parallel rows, the young animals being afterwards turned loose in paddocks and fed, if very young, on milk from bottles fitted with rubber suckers. When tame enough, they were allowed out to graze with zebu cows herded in the same paddock and from which they never attempted to stray. In this way he was eventually able to drive a mixed herd of cows, antelopes and other animals, and ostriches down to the Victoria Nyanza or to the coast for shipment.

Life and Mechanism.

The Sceptical Biologist (Ten Essays). By Joseph Needham. Pp. v+288. (London: Chatto and Windus, 1929.) 7*s*. 6*d*. net.

OF these ten essays, seven deal with different aspects of a single topic, the character of the biological sciences and their status among the other sciences. Arising out of this question the relations between science and philosophy and other human activities are considered. Dr. Needham writes in a gay and even frivolous manner, but the subjects he deals with are serious and what he has to say is important. He does not claim that his main thesis is new, but he might justly claim that it has never been better stated.

The gist of the matter may be put in a few sentences. "The biologist is not committed to any opinion as to what his animals are in themselves, but he is committed to the opinion that the scientific method is one way of describing them, and that it is best to apply that method in its fullest rigour if it is to be applied at all" (p. 253). "The mechanistic conception of living organisms is necessitated by the fact that science is, above all, a system of measurement. What can be weighed or made measurable is susceptible of scientific treatment; elements of experience which cannot be so discussed are left on one side until they can" (p. 136). "The neo-mechanistic position, therefore, at one and the same time asserting the universal dominion of the mechanical sort of explanation over all nature, living and non-living, and admitting the inadequate nature of this sort of explanation as a full account of the world, resembles the old mechanisticism in maintaining the heuristic need for the machine, and differs from it in seeing nothing solely ultimate about the machine. It thus recognises itself as the way the scientific mind goes to work, and not the manner of thinking in philosophy, theology, and art" (p. 204). Everybody, in fact, who works in a laboratory has to be a mechanist while he is at work. Outside he may think what he likes. The mechanistic theory is like army discipline—necessary for the soldier on duty but intolerable otherwise.

While each individual essay can be unreservedly recommended, read together they do not make a good book. They resemble too much having to eat a succession of teas instead of a dinner.

The three other essays in the book are of a biographical character, but are not unconnected with the main theme of the others. One is on a forgotten biological essay by Coleridge; one on de la Mettrie, the author of "Man a Machine"; the third on the seventeenth century trials for witchcraft and Harvey's connexion with them. Unfortunately, it appears that Harvey never divulged his views on witchcraft, but the nature of his evidence at the trials combined with this very reticence seems to leave a presumption that he was sceptical. The essay is a very interesting little historical sketch.

The author displays a disconcertingly wide knowledge of scientific and philosophical literature and has a happy knack of quotation from unexpected sources. For this reason it is specially disappointing to find the bibliography incomplete. A. D. R.

Our Bookshelf.

Ethnography

The Corridors of Time By Harold Peake and Herbert John Fleure Vol 5 *The Steppe and the Sown* Pp 160 Vol 6 *The Way of the Sea* Pp viii + 168 (Oxford Clarendon Press, London Oxford University Press, 1929) 5s net each

IN these two volumes the authors of the "Corridors of Time" pass definitely to that phase of archaeological studies in which the comparative method on broad lines must at the very least take equal place with the intensive study of local conditions

Each of these two volumes has, in a sense, a dramatic unity and a central theme, better expressed perhaps in the title of the first than the second In "The Steppe and the Sown" the nomads of the plains of southern Russia, who, as it has been suggested, may have been the earliest Aryans, made more mobile by the domination of the horse, overrun and conquer the agricultural peoples, settling as overlords in eastern and central Europe, and ultimately reaching or affecting Mesopotamia, the Troad, the Balkans and Greece, Crete, and even Egypt, possibly giving rise to the Hittite Empire at a date later than that to which this volume extends "The Way of the Sea", which carries the story down to about 2000 B C, deals not so much with the migrations of peoples as the great movements of cultures, world wide and more or less lasting in their effects on indigenous civilisation, whether due to actual racial contact or to trade, not only by sea but also by land routes The range and character of the megalith, the spread of a knowledge of the use of metal, and the distribution of the 'beaker' are interpreted in terms of a widely extending continuity of contact

The authors have analysed the evidence with no little ingenuity in attacking some crucial difficulties In particular their view that the spread of the beaker must be regarded as a westward movement from eastern Europe seems more in accord with probabilities than that which regards it as an eastward spread from Spain Their treatment of the history of the great centres of civilisation, Mesopotamia, Babylon under Hammurabi, the beginnings of the Hittite Empire, Crete and the eastern Mediterranean and Egypt, is necessarily summary in character and can touch only on the evidence for the main trend of events

The Heroic Age of India a Comparative Study By Prof N K Sidhanta (The History of Civilization Series) Pp viii + 232 (London Kegan Paul and Co, Ltd, New York Alfred A Knopf, 1929) 12s 6d net

AN account of the heroic age of India fittingly finds a place in a series which aims at covering the history of civilisation Regarded integrally in its effect on the life of the peoples of India, the heroic age, as a phase of culture, must rank as an epoch of fundamental importance, but it has also to be recognised that in all probability it is, in mythical form, a record of one of a number of racial movements in world history which, having certain features in common, are mutually illuminative, and even in some cases may be interrelated Prof Sidhanta, throughout his study of the heroic age of India, points out again and again the similarities in the epic stories contained in the Mahabharata, the Puranas, and the Ramayana, and those of the Iliad and Odyssey, Beowulf, and the Serbian cycle of Marko, the hero of the battle of Kossovo

Study of the Indian epic cycle presents grave difficulties to the student who is not also an expert in the interpretation of Indian literature The religious and philosophic interest of a later age has remoulded these stories, thrusting the more purely heroic theme into the background Prof Sidhanta has done a valuable service in extracting from the poems the material which serves to throw light upon the chronology, the social system, and the religion enshrined in the tangled story of the heroes in the great struggle between Kauravas and Pandavas

As has been said, the author refers frequently to the other great heroic sagas in the world's history In seeking to explain the genesis of the heroic epic and the conditions of society which the heroic epic depicts, his method is literary rather than sociological Had he carried his analysis a little further and on sociological lines, it would have been apparent that the resemblances represent a racial reaction—the reaction of Nordic peoples—to analogous conditions

(1) *People of the Small Arrow* By J H Driberg Pp v + 338 (London George Routledge and Sons, Ltd, 1930) 10s 6d net
(2) *Jungle Gods* By Carl von Hoffman Edited by Eugene Löhrke Pp xxiv + 286 + 20 plates (London Constable and Co, Ltd, 1929) 10s net

(1) MR DRIBERG's "People of the Small Arrow" is a graphic description of characteristic events in the life of the Didinga of the hill country of the Sudan bordering upon Abyssinia The name here used is derived from the miniature arrow with which they bleed their cattle Mr Driberg was the first European to visit them, and a residence of some years among them has given him an intimate knowledge upon which he has been able to base these sketches of the normal course of their daily life Drought, warfare, cattle tending, agriculture, love, marriage, birth and death, are all described graphically as we would look to a novelist or descriptive writer to deal with the life of a community in a western civilisation Mr Driberg's special, and it may be said difficult, task has been to make intelligible the springs of action in custom and belief which determine the conduct of the individuals as individuals and as members of the social organism

(2) In "Jungle Gods", Capt v Hoffman is

dealing with a people still primitive in idea but no longer untouched by European culture These are the Lala, a people of north-eastern Rhodesia His method of treatment is comparable with that of Mr Driberg It is that of the graphic sketch of concrete incident and the record of ideas on specific points of belief and custom of the people themselves Here again it is possible to grasp the significance of magical ideas in their effect in action Particularly interesting is the way in which the author has brought out the psychology of the native attitude towards the missionary and other white activities

Taken together, the two books are of special interest in showing how graphic studies of this type may be made to supplement the scientific record of observations in the field They demonstrate how the beliefs, customs, and institutions described by the ethnographer function in the events and relations of everyday life

Le royaume d'Arda et son évangélisation au XVII^e siècle Par Prof Henri Labouret et Prof Paul Rivet (Université de Paris Travaux et mémoires de l'Institut d'Ethnologie, Tome 7) Pp iv + 63 + 20 planches (Paris Institut d'Ethnologie, 1929) 30 francs

THIS, the latest issue of the interesting series published by the Institut d'Ethnographie of Paris, deals with an intriguing problem in ethnography and geography It turns upon a small octavo book in the library of San Isidro in Madrid which came from the Imperial Jesuit College, and contains a vocabulary and exposition of the Christian doctrine in the 'Arda Language' It is dated 1658 The language was identified in 1858 by Ludewig as being that of an Indian tribe of the upper waters of the Amazon, and akin to the Yamio whom the Jesuits attempted to evangelise from 1727 to 1768 An examination of a photographic reproduction of the vocabulary, however, as well as the discrepancy in the date and the fact that it was the work of Capucins and not Jesuits, led the authors to doubt this attribution Certain words in the vocabulary were undoubtedly African They accordingly now identify it as the language of Allada on the Slave Coast, the cradle of the dynasty of Dahomey before it was made subject to the kingdom of Abomey in 1724 The title page of this interesting volume and the vocabulary are reproduced photographically with other interesting plates from early voyages

Psychology

The Morality of Punishment with some Suggestions for a General Theory of Ethics By Dr A C Ewing Pp xiv + 233 (London Kegan Paul and Co , Ltd , 1929) 10*s* 6*d* net

BOOKS upon the subject of punishment are usually written by humanitarians, cranks, or persons with some sort of a doctrinal axe to grind—theological or psychological Dr Ewing, however, contributes a thoroughly well thought-out and well informed dissertation, which will be read with profit by magistrates, schoolmasters, and clergymen, as well as with sustained delight by philosophers and students of ethics

Since Dr Rashdall wrote his well known chapter, "Punishment and Forgiveness", in his "Theory of Good and Evil", there has been nothing written in Great Britain of serious import on the subject, as Dr W D Ross points out in his foreword The author aims at reconciling the retributive and the deterrent theories of punishment in such a way as to do justice to the elements of value in both Such elements, indeed, do exist , and Dr Ewing, though repudiating the more savagely logical of retributive theories, has no difficulty in showing that the deterrent theory may be held and put into practice in such a way as to presuppose no visible moral point of view at all For the deterrent theory (logically applied) presupposes in the criminal only a capacity for feeling pain, not of any moral sense as such

Dr Ewing deals further with educative ideas of punishment, and also with the complementary theory of reward He adds a long chapter on the bearing of moral theory upon practice—that is, on the question how we are to decide in particular cases of conduct , a problem too much left by moral philosophers to the casuists whose inspiration has often been theological rather than humane Dr Ewing's work is of great value, and deserves careful study, not only by theorists but also by men of affairs It is commendably readable—not a common quality in treatises on ethics

The Foundations of Experimental Psychology By H Banister, Philip Bard, W B Cannon, W J Crozier, Alexander Forbes, Shepherd Ivory Franz, Frank N Freeman, Arnold Gesell, H Hartridge, Selig Hecht, James Quinter Holsopple, Walter S Hunter, Truman L Kelley, Carney Landis, K S Lashley, Mark A May, T H Morgan, John Paul Nafe, George H Parker, Rudolf Pintner, Eugene Shen, L T Troland, Clark Wissler Edited by Carl Murchison (The International University Series in Psychology) Pp x + 907 (Worcester, Mass Clark University Press , London Oxford University Press, 1929) 27*s* net

THE purpose of this large and comprehensive volume, issued from Clark University, one of the recognised homes of psychological research, is to indicate just where we stand at the present time in regard to the experimental method of inquiry in this field To review such a book in detail would be a rather hopeless task, since it consists of no fewer than twenty three independent studies of the subjects finally selected for treatment But many of our readers will be glad to have an indication of the contents of the volume

Chapters on heredity, the study of living organisms, and the mechanism of reaction, are followed by several chapters on the senses, two on emotion, and two on the psychology of learning Then follow studies on the individual in infancy and in school, the adult in the community, and the conflict and survival of cultures The last two chapters deal with statistical principles, of course with special

reference to their application to psychological problems Care has been taken to exclude problems which promise little reward for experimental inquiry, and to avoid saying over again what has been said many times before

The whole book may be regarded as an authoritative report on the present state of its subject, and we are promised that it shall be kept up to date by frequent revision The book represents a big enterprise worthily accomplished

Biology

Die Binnengewasser Einzeldarstellungen aus der Limnologie und ihren Nachbargebieten Unter Mitwirkung von Dr Einar Naumann und anderen Fachgenossen herausgegeben von Prof Dr August Thienemann Band 7 *Die Biologie der Moore* Von Dr Otto Harnisch Pp iv + 146 16 marks Band 8 *Der Hochgebirgsee der Alpen (Versuch einer limnologischen Charakteristik)* Von Dr Otto Pesta Pp xi + 156 + 8 Tafeln 17 50 gold marks (Stuttgart E Schweizerbart'sche Verlagsbuchhandlung (Erwin Nagele) G m b H , 1929)

FOLLOWING Dr Einar Naumann's excellent introduction to experimental fresh water plankton investigations in Vol 6 of the present work, we are now given treatises on the biology of the moor by Dr O Harnisch (Vol 7), and on the high mountain lakes of the Alps by Dr Otto Pesta (Vol 8) Both of these are highly interesting, and the student of fresh water biology will find much to help him, whichever region he wishes to investigate The plan of the volumes is similar, although naturally differing to a large extent in matter The first part treats of the geographical and geological features with the chemical constituents of the soil and water, and following this are descriptions of the fauna and flora of these distinctive regions

Dr Harnisch begins with certain necessary definitions and proceeds to describe the moor in all its aspects, including its development and history, the chemical and physical nature of the soil and the moorland waters—stream, lake, and bog, the trees and turf , finally, the plant and animal life The importance of *Sphagnum* to the Rhizopoda and other small creatures, always well known, is emphasised Special stress is laid on animal communities and their environment , the whole forming an excellent basis for further work

Dr Pesta, who has himself investigated many of the high Alpine lakes, gives a valuable account of them Most of these lakes have little or no vegetation round them, being situated chiefly between the mountains and surrounded by rocks and stones The hydrophysics, including colour and transparency, temperature and winds, are here of great importance The flora and fauna are mostly made up of cosmopolitan species with a small group of cold-water forms of restricted distribution The lists given include a large variety of plants and animals, and special problems arise out of these, such as the restriction of food in the winter and consequent hunger-forms, the presence of red coloration in many species, and other suggestive points

A Manual of External Parasites By Dr H E Ewing Pp xiv + 225 (London Baillière, Tindall and Cox, 1929) 20s net

THIS attractively printed manual, notwithstanding its title, is not a general book on ectoparasites, but a guide to the study of certain economically important groups Its author, Dr H E Ewing, is a well known member of the United States Bureau of Entomology, and in preparing this book he has been able to draw upon the extremely complete collections of the creatures he deals with that are contained in the National Museum at Washington The first five chapters are devoted respectively to mites, ticks, biting lice, sucking lice, and fleas Each of these sections contains keys to the families and genera, together with some considerations of the external anatomy, economy, and control measures, while representative species are shown in the illustrations At the end of each chapter is a list of the more important literature on the subject concerned the references are well chosen, and by no means confined to American writers The sixth and final chapter takes the form of an appendix containing descriptions of a number of new genera of ectoparasites The wisdom of this procedure is disputable, but, it may be added, the new genera described are included in the keys given in the foregoing sections

It is a matter of regret that the book is not larger, and its utility is limited in consequence Its chief value is that it provides a guide to the identification of the groups of ectoparasites dealt with, and we know of no other single work wherein there are to be found diagnostic keys of a similarly comprehensive character Museum workers, general entomologists, and veterinarians will find the book of real assistance in this respect From the general point of view, however, the information on structure and biology is not given in the detail which might reasonably be expected in a specialised book of this description, and the same applies to the accounts of control measures

Tabulæ Biologicæ Ed W Junk, Herausgegeben von C Oppenheimer und L Pincussen Supplement 1 (Band 5) *Botanik , Biologie der Algen , Bakteriologie , Hefen und Schimmel Pilze , Geschlechter Verteilung , Kern Plasma-Relations , Keimung , Wachstum , Allgemeine Physiologie , Assimilation , Periodizität , Experimentelle Ökologie* Pp vi + 821 (Berlin W Junk, 1929) 90 gold marks

THIS volume is supplementary to the original four It deals entirely with botanical data and is to be followed by a zoological volume A variety of matters relating to the biology of plants are tabulated Beginning with a list of all the species of algæ which have been cultured, many other facts which are amenable to tabulation concerning algal cultures are given In similar fashion, many facts concerning bacterial and fungal culture and media are tabulated Sections follow dealing with such subjects as sex in plants, germination, growth, and many other physiological topics in tabular form Another section is ecological, and the volume ends

with an appendix on enzymes and an index of all botanical references in the five volumes

References to the literature are given at the beginning of each table and at intervals in each section Much out of the way information is conveyed, which will be useful for reference But in some cases the tables would be more useful if the method of computing the results was given Thus in the table giving the nucleoplasmic ratio in embryonic organs, reference to the original paper would be necessary to determine how the volumes were computed Numerous graphs and four plates of figures of yeasts and moulds add to the value of a volume which should be of use both to morphologists and physiologists

Handbuch der biologischen Arbeitsmethoden Herausgegeben von Prof Dr Emil Abderhalden Lieferung 293 Abt 9 *Methoden der Erforschung der Leistungen des tierischen Organismus*, Teil 4, Heft 3 *Methoden der Erforschung bestimmter Funktionen bei einzelnen Tierarten Methoden und Technik der Nerven und Muskel physiologie bei wirbellosen Tieren* Von H J Jordan und P J van der Feen Pp 295-438 (Berlin und Wien Urban und Schwarzenberg, 1929) 8 gold marks

THE present sub section of this comprehensive undertaking will be found especially useful to workers in marine and in general physiology, as well as to those devoting themselves to the study of muscle and nerve phenomena General methods for the investigation of the tone of smooth muscle are described, as well as special details of technique for dealing with the representative types of invertebrates

What Darwin Really Said connected Extracts from the "Origin of Species" With an Introduction by Prof Julian Huxley (Routledge Introductions to Modern Knowledge No 8) Pp 80 (London George Routledge and Sons, Ltd, 1929) *6d* net

BY a judicious selection of extracts, Prof Huxley here presents the pith of Darwin's argument in support of the theory of natural selection, and in such a way that the layman in biology should have no difficulty either in grasping the essentials or in avoiding misconceptions The introduction, after showing the far reaching effect of the appearance of "The Origin of Species", contains a valuable discussion of the present position in the light of recent advances in biological knowledge, especially of Mendelism, while occasional footnotes direct attention to facts not known to Darwin A short bibliography of modern works relating to evolution, and a glossary, are included

Insect Pests and their Control in South Africa By Dr Charles K Brain Pp xii + 468 + viii (Cape Town Die Nasionale Pers Beperk, 1929) n p

IN view of the enormous losses occasioned by insect pests to the farmers of South Africa, we welcome this first attempt to provide them with a manual of the subject, with methods of control Dr Brain has brought to his task wide experience of his subject and has succeeded in producing a thoroughly sound, well-illustrated book which is both practical and scientifically accurate Within a compass of rather more than 460 pages, he discusses every pest of importance to the grower and stock raiser in South Africa, besides providing chapters on bee keeping, the relations of insects to human and animal diseases, and the general principles of control methods

English Wild Life By Eric Parker (The English Heritage Series) Pp xi + 180 (London, New York and Toronto Longmans, Green and Co, Ltd, 1929) *3s 6d* net

THAT the old order changeth is sadly true of the English countryside to those whose memories extend back to the last century It is thus good to have this record of what the wild life, both animal and plant, of England has meant and means to an all round naturalist and (*quondam*) sportsman who has a knowledge of the fauna and flora of moors and fields, woods and forests, foreshores, rivers, lakes, and mountain peaks May his pleasant little volume achieve some measure of preservation of our heritage before it is too late

Animals Looking at You By Paul Eipper Translated by Patrick Kirwan Pp vi + 187 + 32 plates (London and New York G P Putnam's Sons, 1929) *10s 6d* net

THIS remarkable work should be read by all zoologists and others interested in animal life It consists of what can best be described as a series of vivid verbal vignettes of incidents observed at Hagenbech's Stellingen zoo and elsewhere, and reveals much of the characters and temperaments of the great beasts and birds lodged in such establishments The thirty two magnificent photographic illustrations are as striking as the text itself The translation is very well done

Geography

Practical Hints to Scientific Travellers Edited by Prof H A Brouwer Vol 6 Pp v + 177 + 12 plates (The Hague Martinus Nijhoff, 1929) 5 guilders, *8s 6d*

THE sixth volume of this useful work, which now appears in a handier form than that of the first two volumes, treats of travel in Canada, the Argentine, Madagascar, tropical West Africa, and Oceania The articles vary in scope and treatment, as is obviously desirable in such diverse regions, but all are of an entirely practical character and should be very helpful to the scientific traveller No attempt is made to compete with volumes on various aspects of the countries or to furnish guides or handbooks Attention is concentrated on methods of travel, equipment, maps, food, and manners and customs that might affect the traveller The articles on the Argentine and West Africa are specially valuable, but all are useful and are written by men of practical experience

Greenland its Nature, Inhabitants and History By Th N Krabbe Translated from the Danish by Annie I Fausbøll Pp xvi + 129 + ix + 170 plates (Copenhagen Levin and Munksgarrd, London Oxford University Press, 1930) Paper, 33*s* net, cloth, 40*s* net

DR KRABBE spent the best part of twenty years as a physician in Greenland, during which time he visited most of the inhabited parts He is thus exceptionally well qualified to give a general account of the country, and particularly its inhabitants and their social conditions The book, which is printed in parallel columns in Danish and English, gives an admirable survey of the present state of the country and a sketch of its history It is of interest to note that the native population, under the care of the Danes, has increased from 10,000 in 1886 to more than 14,000 in 1926

The chief value of the volume, however, lies in its beautiful illustrations The numerous plates, which are provided with full descriptions, give a pictorial survey of Greenland on a scale that no other volume has attempted Many of the settlements are illustrated and the inhabitants receive special attention There are also fifty portraits of men who have been closely connected with the exploration of the country A full index and a good map add to the value of the volume

R N R B

Shipways to the Sea our Inland and Coastal Waterways By Ernest S Clowes Pp viii + 196 + 6 plates (Baltimore, Md Williams and Wilkins Co, London Baillière, Tindall and Cox, 1929) 20*s* net

THE author of this excellent survey of the waterways of the United States, and, in part, Canada, believes that the development of inland navigation is needed to solve many of the problems of cheap and efficient transport in America He develops this idea particularly in regard to the Mississippi basin and the interior plains of the United States The book, however, is not merely a piece of propaganda It embraces a historical, geographical, and economic survey of all the existing navigable rivers, canals, and lakes with a wealth of useful statistics Projects in hand and dreams of the future are also discussed The consideration of the proposed St Lawrence waterway for ocean going vessels is particularly valuable, because it appears to be free from the political bias which affects most discussions of this subject The volume contains a few maps, but they should have been clearer and more numerous

Open-Air Studies in Australia By Frederick Chapman Pp xx + 170 + 23 plates (London and Toronto J M Dent and Sons, Ltd, 1929) 10*s* 6*d* net

FOR full appreciation of this series of essays, personal acquaintance with the soil and scenery of Australia are necessary Nevertheless, the fundamental principles involved are of such universal application, and the allusions to features within the British Isles so frequent, that the reader who has a taste for open-air geology can be assured of interest in every chapter Incidentally, attention may be directed to the chapter "The Problem of the Coral Island", and the discussion of the results of the Funafuti Expedition Most of the illustrations are excellent, but a few are inconveniently small

Mathematics

Mathematics Preparatory to Statistics and Finance By George N Bauer Pp vii + 337 (New York The Macmillan Co, 1929) 8*s* 6*d* net

THE flood of elementary treatises dealing with statistics continues unabated, nearly all seem to be designed to aid students whose subjects are known or believed to require statistical methods, but who have already decided that they have neither the time nor the mathematical training to make themselves masters of the simple principles on which competent methods are founded The authors of these heroic stopgaps cannot fairly be blamed for this situation, so long as the large portion of the population which will need statistics in its practical business does not imbibe the fundamental ideas in their school mathematics, so long will university students require such courses as that under review The author shows a just perspective in saying (Preface, p v)

"This is not a book dealing with the subject of statistics, neither does it attempt to present the subject of the mathematics of finance It is a study of the simpler mathematical methods and principles that occur frequently in elementary courses in these subjects But many of the principles and methods included are applicable to the study of phenomena in other fields They have a wide range of usefulness"

The range of usefulness would certainly be greater if care had been taken to use common expressions in the sense which they bear in more advanced work On p 252 the 'standard error of an estimate' is spoken of as a test of 'goodness of fit' This it certainly is not The confusion which here lies in wait for those adventurous souls who ultimately win through to real tests of goodness of fit, is made worse by the fact that the standard error under discussion is not the standard error of the estimated regression, but a rather unsatisfactory estimate of the standard deviation from a regression formula

Within its own limits, however, the book makes the subject easy Explanations and examples are careful and abundant R A FISHER

Mathematical Tables and Formulas By Prof Percey F Smith and Prof William Raymond Longley Pp v + 66 (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1929) 8*s* net

THIS collection of tables, mostly to four figures, contains logarithms, square and cubes, square and cube roots, reciprocals, Napierian logarithms and trigonometrical tables No differences are given In addition, there is a three figure radian table giving the six natural trigonometrical functions for arguments up to 3 20 This and the corresponding table of exponentials and hyperbolic functions are

definitely useful It is therefore a pity that they were not made more extensive instead of being cramped into four pages The formulæ, which occupy 25 pages, are not so well chosen There are no formulæ of spherical trigonometry, nor are the derivatives of hyperbolic functions and their inverses given Taylor's and Maclaurin's series should include a remainder term The table of integrals is, however, welcome The book is well bound and has a thumb-nail index, but the price is rather high

The Adjustment of Errors in Practical Science By R W M Gibbs Pp 112 (London Oxford University Press, 1929) 5s net

THIS little volume is "the result of an attempt to simplify and condense into a readable form the gist of the Theory of Errors" It deals with the elements of probability, normal curves of error, distribution of errors, lines of closest fit, correlation coefficients and ratios, observational errors, and so on The text is clearly and simply written, and is well illustrated by graphical diagrams The chief mathematical theorems upon which the theory of error depend are not given in the text, but are established separately in an appendix at the end Here the author has wisely aimed at giving clear and simple demonstrations in order that the mathematical treatment may be within the range of the non specialist In this he has in general succeeded , nevertheless, a fair amount of mathematical knowledge is necessary to appreciate fully some of the proofs, especially those dealing with the fundamental integrals

Lists of common symbols and special formulæ used throughout the book are given at the end, and an excellent system of cross-reference has been adopted

Elementary Differential Equations By Dr Thornton C Fry Pp x + 255 (London Macmillan and Co , Ltd , 1929) 10s 6d net

THIS volume is intended primarily for students of engineering, and is the outcome of 'out-of-hour' courses given at the Bell Telephone Laboratories It embraces the significance and origin of differential equations, linear equations of the first and higher orders, systems of linear equations and other equations of a higher order than the first The treatment is mainly practical, but a little elementary theory is included

The author recognises the danger of dealing solely with technical applications and has made a commendable attempt to develop sound mathematical principles so far as is possible in such a treatise Thus, there are sections devoted to brief elementary discussions on existence theorems, continuity, singular solutions, boundary conditions, essential conditions of convergence in series solutions, etc There is a good chapter on the geometrical interpretation of a first order equation, and the book is full of excellent examples bearing on a variety of important applications

The text is well arranged and printed, and the few necessary diagrams are very clearly drawn

Physics and Chemistry

(1) *Molecular Spectra and Molecular Structure a General Discussion held by the Faraday Society, September 1929* Pp iii + 611-954 (London The Faraday Society, 1929) 15s 6d net

(2) *Bandenspektra und ihre Bedeutung fur die Chemie* Von Prof Dr R Mecke (Fortschritte der Chemie, Physik und physikalischen Chemie, herausgegeben von Prof Dr A Eucken, Band 20, Heft 3) Pp iii + 87 (Berlin Gebruder Borntraeger, 1929) 7 60 gold marks

(1) THE Faraday Society's General Discussion on Molecular Spectra and Molecular Structure, held at Bristol on Sept 24–25, 1929, has already been reported in these columns (Oct 12, 1929) The full report, which has now been issued as a separate publication, is remarkable in that it contains not less than forty original papers, together with verbal and written contributions to the discussion It is, therefore, unsurpassed as a comprehensive survey of the important subject with which it deals, and has the special merit of being many months in advance of any volume that could be written by the most experienced author, since it discloses for the first time new facts and new opinions that can only gradually find their way into even the most up to date text books

(2) One of the most welcome visitors to the Bristol meeting was Prof Mecke, of Bonn, the joint author of a paper on "The Absorption Spectrum of Ammonia Gas in the Near Infra red" Prof Mecke is also the author of a monograph on "Band spectra and their Significance for Chemistry", published in a well known series of *Fortschritte*, or progress reports, on chemistry, physics, and physical chemistry A recent monograph of this series, on the valency number and its relation to the structure of the atom, was reviewed at length in these columns nearly a year ago (NATURE, April 13, 1929) Since the logical sequel to the study of line spectra of atoms is obviously that of the band spectra of molecules, those chemists who have read the former monograph in order to secure some knowledge of atomic physics will obviously be well advised to extend their studies to the latter monograph, which records the spectroscopic behaviour of chemical compounds and therefore presents a much wider field for the consideration of chemical problems In particular, those who wish to appreciate the technicalities of the Bristol report will find in Prof Mecke's monograph an excellent introduction to a very modern and somewhat difficult subject

Physikalisch-chemisches Praktikum Von Prof Dr K Fajans and Dr J Wüst Pp xvi + 217 (Leipzig Akademische Verlagsgesellschaft m b H , 1929) 13 50 gold marks

THE "Physikalisch-chemisches Praktikum" of Prof Fajans and Dr Wust had its origin in instructions for experiments in physical chemistry which were prepared in 1910 by Prof Bredig and his colleagues for use in his laboratory at Karlsruhe Ten years of continuous service in Munich resulted in so many modifications that finally a plan was

developed whereby the experience gained there was united with that of Prof Grimm at Würzburg and of Prof Schiebe in Erlangen and used to produce a book which would meet the requirements of the four laboratories mentioned above

The principal purpose of such a book is to lighten the burden which rests upon demonstrators who may now be required to cope with very large classes, as a result of the introduction of compulsory courses in practical physical chemistry Its value can only be tested adequately by use in the country of origin, and English teachers will probably find it necessary to base their courses on instruction sheets or laboratory text books in their own language, but they will find it of interest to compare notes with their German colleagues, and in some cases (for example, the experiments illustrating radio active transformations) they may find material for developments in directions not hitherto exploited in undergraduate courses The practical instructions are accompanied by theoretical sections, and references are given to German text books in which the points at issue can be studied more fully

Stereoscopic Photographs of Crystal Models Edited by Sir William and Prof W L Bragg in order to illustrate the results of X ray Crystallography Second series *The Silicates* (London Adam Hilger, Ltd, 1929) Set of 23 photographs complete in box with folding stereoscope, 24*s* 9*d*

THIS second series of stereoscopic photographs represents models of the structures of important members belonging to the silicate family The original models were built up from results based on X ray investigations, and they have been constructed with such simple materials that the student may be tempted to reproduce the simplest ones from the data printed on the back of each photograph Seeing that the atoms in these structures make up nearly the whole of the earth's crust, this simple presentation of the results of a difficult physical research will be of great interest in many fields

The key to each model is the regular grouping of the large oxygen atoms, the silicon and metal atoms being widely dispersed throughout the structure and adding, as it were, more complex harmonies to the central oxygen 'motif' Both the close packed and open structures of oxygen atoms are well represented These examples of complex co-ordination are made up of simple units, notably tetrahedral groups of oxygen atoms around silicon, and octahedral groups of oxygen atoms around aluminium The units are repeated rhythmically, often in chain or ring formation when they share one oxygen atom The variable co ordination number of aluminium is of particular interest to the chemist andalusite provides an example of this atom being situated between five oxygen atoms

It is to be hoped that photographs of models of the felspars, micas, and zeolites will form a nucleus for a third series To the mineralogist remains the formidable task of finding how closely these ideal models represent the structure of all the members of a mineral species, within which the chemical composition often varies widely F A B

Das Fermentproblem (zugleich Einführung in die Chemie der Lebenserscheinungen) Von Prof Dr Andor Fodor Zweite, völlig umgearbeitete Auflage Pp xi + 283 (Dresden und Leipzig Theodor Steinkopff, 1929) 20 gold marks

THE author's aim in the present edition of his book has been to prepare a concise treatise on fermentation phenomena, embodying the more recent discoveries, without attempting to treat the subject exhaustively The difficulties of dealing, within a limited compass, with a subject having so profuse a literature, are frankly admitted by Prof Fodor

The book is divided into five sections, each of which is subdivided A short account is given in the opening section of the history of fermentation The physiology of digestion is next dealt with, and a detailed account is given of the products resulting from the action of enzymes Some of the text in this part of the book is inclined to be one sided, thus, that concerned with starch hydrolysis is almost exclusively confined to the work of German chemists A useful summary is given of the enzymes of animal organs and of prophylactic ferments The section on assimilation and dissimilation is a long one, describing photosynthesis, respiration—aerobic and anaerobic—and setting forth the views of Bach and Chodat, Warburg, Wieland, and others Here also the final excretion products of animal metabolism are dealt with There is a section on the physical chemistry of enzymes, whilst the subject matter of the concluding section of the work is concerned with colloidal chemistry in its relation to the activity of enzymes A subject matter index is provided

Whilst regarding the book as a useful addition to the literature, after reading the sections the feeling can scarcely be avoided that it lacks that personal touch so desirable in a work intended for didactic purposes A R L

Analytical Processes a Physico Chemical Interpretation By T B Smith Pp viii + 373 (London Edward Arnold and Co, 1929) 12*s* 6*d* net

DR T B SMITH has written a book of a very unusual type, since it is neither a text book of analysis nor a text book of physical chemistry, but a review of the processes of analysis in the light of modern knowledge and of physico-chemical laws For this purpose he has considered a series of analytical operations, such as the precipitation of barium sulphate, lead sulphate, ferric hydroxide, and silver halides, the titration of chlorides against silver nitrate, of acids against alkalis, and of oxidising against reducing agents, and the methods of electro-analysis, and has brought to bear on them a wealth of physico chemical experience which may win the admiration even of a well read student of physical chemistry

The book also includes chapters dealing with the ignition of precipitates, analytical separations, super saturation and crystallisation, colloidal phenomena

and complex ions, each of which contains a satisfying review of current knowledge The author has, in fact, first become a keen student of the science (as distinct from the art) of analysis, and has then set himself the more difficult task of passing on to others the scientific equipment and critical skill which he has himself acquired The volume in which this has been done is a noteworthy production, and may be commended heartily to all those who are responsible for teaching analysis, as well as to those who may value it for the additional interest which it may give to analytical practice

Miscellany

The Evolution of Earth and Man By Lorande Loss Woodruff, George Howard Parker, Richard Swann Lull, Charles Schuchert, Harry Burr Ferris, Joseph Barrell, Albert Galloway Keller, George Grant MacCurdy, Ellsworth Huntington, James Rowland Angell, Edwin Grant Conklin, Wesley Roswell Coe Edited, with a Preface, by Prof George Alfred Baitsell Pp xv + 476 + 32 plates (New Haven, Conn Yale University Press, London Oxford University Press, 1929) 22*s* 6*d* net

THIS volume consists of a reprint of two volumes of elementary lectures, "The Evolution of the Earth and its Inhabitants" (1918), and "The Evolution of Man" (1922), delivered at Yale University, with the addition of a chapter entitled "Cultural Evolution" by Prof G G MacCurdy, and another on "The Mechanism of Evolution", by Prof W R Coe Most of the chapters are reprinted without any (or with only slight) alteration Hence the review that appeared in NATURE (June 2, 1923, p 735) still gives an accurate idea of the new impression, and the criticism of the titles of the individual lectures and of the whole volume is still relevant

The new chapters are summaries of well known evidence, which omit a good deal of modern research For example, the beginning of the Bronze Age is given (p 285) as 3000 B C, although it is now generally admitted that the alloy was not invented before 2500 (or perhaps even 2000) B C, and some time must be allowed for the building up and diffusion of the culture complex which in western Europe was called 'The Bronze Age' The beginning of the Neolithic Period is assigned to 12,000 B C, which is about nine or ten millennia too early

Nature Cosmic, Human and Divine By James Young Simpson (The Terry Lectures, Yale University, 1929) Pp ix + 157 (London Oxford University Press, 1929) 6*s* net

PROF J Y SIMPSON'S three Terry Lectures delivered at Yale last year will interest those students of science who are not indifferent to the speculative and religious bearings of their subject The first lecture summarises the results of recent astronomical and physical science The second lecture, which is anthropological, takes an optimistic view of human nature, accepting Elliot Smith's view that 'savagery' is not natural to man, and expressing the opinion that "human nature not merely can be, but is being changed", and (what seems too good to be true) that 'we stand on the threshold of an Age of Reason"

The final lecture essays to present us with some sort of a philosophic synthesis in terms of trends and tendencies "The association of mind with the energy at work in the world process is forced on us in contemplation of the sustained and broadly progressive character of the process as a whole, with its present *dénouement* in man" The Christian theologian will discover in this last chapter a point of view indistinguishable from the *Logos* doctrine of the Fourth Gospel, nor would Dante feel that his view of love as the motive power of the world had been neglected Prof Simpson may be congratulated on a very useful piece of work

The Scientific Examination of Pictures an Investigation of the Pigments used by the Dutch and Flemish Masters from the Brothers Van Eyck to the Middle of the 19th Century By Dr A Martin de Wild Translated from the Dutch by Dr L C Jackson Pp xv + 106 + 46 plates (London G Bell and Sons, Ltd, 1929) 15*s* net

DR DE WILD has made an examination of the pigments used in painting Dutch pictures from the fifteenth to the nineteenth century inclusive, by micro-chemical methods, thus enabling him to use tiny samples without injury to the pictures, and carrying on the work done by former chemists such as Raehlmann and Laurie The work, on the whole, confirms the conclusion formerly arrived at as to the pigments used at different periods in painting, but adds much detailed information on the pigments of the Dutch school during this period The beautiful photomicrographs of actual examples are well worth looking at

There are other chapters on the cleaning and preservation of pictures, the examination of them by means of X ray photographs, and by means of ultra violet light

The work is a solid and useful contribution to a subject of growing importance and should find a place both on the bookshelf of the chemist and the picture expert A P LAURIE

Isis or the Future of Oxford By W J K Diplock (To day and To morrow Series) Pp 95 (London Kegan Paul and Co, Ltd, New York E P Dutton and Co, 1929) 2*s* 6*d* net

DISSATISFIED with Mr Julian Hall's "Alma Mater", recently published in the same series, on the future of the two older universities of England, Mr Diplock has produced a sparkling and thoughtful essay on Oxford as it appeared to him during the past five years, when spending laborious days in chemical laboratories, and nights in discussing 'life' and topics of wider intellectual interest with non-scientific friends He not unnaturally prefers the Oxford of his leisure hours, and points out how the 'old academic tradition' may be in danger, if women become too numerous, or if benefactors

prove too commercially-minded, or if 'job hunters' increase At the same time, he notes the absence of heads of colleges who have had a scientific training, whereas Cambridge has often benefited by their ability We hope that Mr Diplock will enlarge further on his theme

Are we Civilized? Human Culture in Perspective By Robert H Lowie Pp xiii + 306 (London George Routledge and Sons, Ltd, 1929) *12s 6d* net

In this amusing and witty book, Prof Lowie has made a survey of human culture with the view of analysing the permanent and impermanent elements in the line of progress His thesis is that man, like the chimpanzee, must fight against the forces of destruction, but he has forged ahead of the ape by passing on his experience to his descendants of the next generation Prof Lowie aims at showing that in so doing he has passed on dross as well as gold In his time and space survey, he shows that identity in difference leads to the conclusion that we our selves, however much we may differ from our ancestors and the so called 'lower races', retain much in our own make up, 'inherited' in the looser sense, which justifies the interrogative which forms the title of his book Prof Lowie holds no brief for the popular theory of Nordic superiority, because, as he says, he does not recognise that a Nordic race exists to day Like everything he writes, the book is stimulating Though scientific in method and outlook, it is written in a style which avoids technicalities and will appeal to the least instructed of readers

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Miscellany

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Exhibition in 1872 and was labelled prophetically "A Young Engineer" The headmaster of his first school, Cargilfield, Edinburgh, encouraged his mechanical tastes When at this school he gave exhibitions with a magic lantern and became skilled in taking photographs In 1877 he took a good photograph of Prof T H Huxley which, with other portraits, is included in a book entitled "Autobiographical and other Writings", which was in the press when he died In 1878 he was sent to Fettes College, but as he hated games he found the school life very uncongenial In his opinion the way Latin and Greek were taught in public schools, especially the unnecessary stress laid on grammar, took away all the romance from the wonderful stories of Greece and Rome He also considered that compulsory games had a tendency to damp out any originality a boy might possess He, however, enjoyed the work in the carpenter's shop at Fettes

In 1879, after reading the description of the working of a telephone given by Prof Dolbear, Campbell Swinton constructed a pair of telephones which functioned excellently As the telephone had only been invented some two years previously, this would have been a good piece of work for a scientific worker, for a boy of fifteen it was admirable His house master, thinking that his scientific absorption interfered with his classical studies, made him send the telephones home

In the easter of 1881, Alan was sent at his own request to Havre, where he had lessons in mathematics and French, but he seems to have spent much of his time in taking snap photographs of ships and fishing boats He also visited the lighthouse on several occasions and studied how the electric arc was fed by a de Meritens dynamo which had permanent steel magnets He was puzzled by the fact that the current seemed to have no effect on a little compass needle brought near it, the reason being that it was alternating current

Campbell Swinton was a great believer in self education The passing of advanced examinations he regarded as pure waste of time He attributed his success to cultivating scientific friends and to attending lectures at institutions like the Royal Institution and the Royal Society of Arts

In 1881, Campbell Swinton visited the Paris Exhibition and was most impressed by the wonderful electrical inventions he saw In 1882 he was apprenticed to Lord Armstrong in the works at Elswick During this period he fitted a Chilian battleship with electric gun firing control which enabled any number of guns to be fired simultaneously In 1887 he left Elswick and set up in London as an electrical contractor and consulting engineer He installed the electric light in many town and country mansions

Early in January 1896, after reading an account in the morning paper of Prof W C Rontgen's discovery of X-rays, Swinton was successful in obtaining a shadow photograph by means of a Crookes tube which he happened to possess A few days later he obtained a shadow photograph of the bones in his own hand The present writer remembers him showing this at the Camera Club, which was then in Charing Cross Road This was the first photograph produced by Rontgen rays in Great Britain It was reproduced in NATURE of Jan 23, 1896 On Feb 4, 1898, he showed many interesting experiments with cathode and X rays at the Royal Institution In conjunction with Sir Charles Parsons, he converted diamond into coke by heating it in a vacuum by cathode rays As the diamond became carbonised, it split up and frothed and became much larger in size The temperature at which this conversion took place was 1890° C

In 1904, Campbell Swinton gave up contracting work and became exclusively a consulting engineer He was specially interested in radio work When the Marchese Marconi first came to England he called on Swinton, who introduced him to Sir William Preece and rapid developments in radio telegraphy soon ensued When in Copenhagen in 1910, Swinton first heard articulate speech by radio when listening to tests with the Poulsen system He was associated with the development of the Parsons turbine and was a director of the Parsons Marine Steam Turbine Co, Ltd He went out on many of the trials of the pioneer turbine boat, the *Turbinia*, which created a sensation at the Naval Review in 1897 by going at the record speed (at that time) of 33½ knots Swinton was one of the pioneers of motoring in England

Campbell Swinton was associated with many electrical works and supply stations He was a director of Crompton, Parkinson, Ltd, and of W T Henley's Telegraph Works, Ltd In 1911 he was president of the Rontgen Society and in 1913 of the Radio Society For several years he was chairman of the council of the Royal Society of Arts In 1915 he was elected a fellow of the Royal Society and twice served on the council In 1926 he presented the Royal Society with £1000 to form the nucleus of a general purposes fund He undertook to defray the costs of the charter which was recently granted to the British Association He had been a member of the general board and of the executive committee of the National Physical Laboratory He was well known at the Athenæum Club, of which he had been a member for nearly thirty years, he was unmarried

Campbell Swinton was a member of the three professional engineering institutions—the Civils, the Mechanicals, and the Electricals He had been a vice president of the Electricals for four years and had served energetically on many committees In his home in Chester Square he was most hospitable, and enjoyed showing to his guests the photographs he had taken of many eminent scientific workers and demonstrating the latest developments in radio communication He will be missed by many, and especially by his old assistants, with whom he maintained a warm friendship

A R

News and Views.

Nearly everyone agrees that radio telephone services with the Dominions and distant foreign countries should be opened up whenever it is economically practical Last August, Imperial and International Communications, Ltd, wrote to the present Postmaster-General, Mr Lees Smith, inviting the Government to work its radio telephone services through the company's stations, beginning with four services to Canada, Australia, South Africa, and India Whilst negotiations were going forward and before the special committee had reported, statements appeared in the Press giving an *ex parte* presentation of the case coupled with a series of charges against the Post Office Mr Lees Smith very properly did not reply until the committee had reported The evidence showed that both the Marconi system and the Post Office Rugby system are capable of providing long-distance services to the Dominions and foreign countries Owing to its invaluable pioneer work on short-wave systems, our sympathies are with the company, but we think that the Government has acted rightly in putting the matter into the hands of the Post Office There is no intention of duplicating the Marconi stations, and there are many advantages in concentrating the plant and buildings at Rugby To work the four services to India and the Dominions through stations belonging to Imperial and International Communications, Ltd, would require 4190 miles of high grade telephone circuits connected with London as compared with 786 miles to connect with the P O stations at Baldock and Rugby In South Africa, also, it would be more economical to erect a station at Johannesburg than to connect with the Company's terminal beam station at Cape Town We do not see that there was any necessity to make a comparative experimental test between the systems before coming to a decision

Scientific and industrial research in the British Empire was the subject of a paper read by Dr A W Hill, director of the Royal Botanic Gardens, Kew, before the Dominions and Colonies section of the Royal Society of Arts on Feb 25 The rapid growth of research in all branches of biological science during the last few years throughout the Dominions and Colonies has created a demand for trained men which it is at present very difficult to meet Dr Hill referred to developments in the West Indies and West Africa In the former, the Imperial College of Tropical Agriculture has been evolved and is recognised as a research station for the study of the many pressing problems which confront tropical agriculture It is also a training centre for agricultural officers for the various agricultural departments throughout the Colonial Empire Botanic stations have been established in West Africa to serve generally for the growth of indigenous trees and plants of marketable value as demonstrations to the natives, for the introduction and propagation of alien plants of economic and commercial importance, and as practical agricultural schools for training the natives The stations have expanded into agricultural departments, that in Nigeria having, in addition to the director, a staff of forty-four scientific officers besides native assistants The research station at Amani, Tanganyika Territory, which was founded by the Germans, has been reorganised as a station for the East African Colonies

Dr Hill emphasised the importance of an intensive taxonomic and ecologic study of the vegetation of the overseas portion of the British Empire, and referred to the important services of Kew, especially in the issue of a series of Colonial floras, and indicated similar works in preparation or projected which would deal in detail with smaller areas The work in progress and in contemplation in connexion with scientific research on the vegetation of the Empire calls for a great increase in the numbers of well-trained botanists both at home and overseas, especially in the domains of taxonomy and ecology, and for the investigation of plants yielding economic products Workers in the field of genetics are also required for the study of staple products, to produce and select true-breeding types which will give a maximum yield There are also the many problems in plant pathology, so closely linked with progress or failure in intensive agriculture Have we the scientific staffs properly equipped throughout the Empire for the great tasks that confront us? In conclusion, Dr Hill quoted from the Norman Lockyer lecture delivered by Sir Walter Morley Fletcher before the British Science Guild in November last and stated that his remarks on the inadequate remuneration and status of those engaged in medical research are equally true with regard to botany and agriculture

The Young Kikuyu movement is again a cause of grave anxiety to the Kenya Government Further, it is stated, attempts are being made to spread unrest to the peaceful Akamba The causes of the present disquiet are reviewed in an article which appeared in the *Times* of Feb 27 In that article the gravity of the situation is by no means exaggerated The Young Kikuyu movement, which has now taken on the form and title of a 'Kikuyu Central Association', is composed largely of younger members of the people who are impatient of the control of the elders and have thrown off tribal restraints In the present situation, however, it is probable that to some considerable extent they will have the support of the elders When it is remembered that the Kikuyu number some 800,000, it is clear that the situation requires statesmanlike handling The chief point now at issue is not one on which conflict is directly with the Government, but the danger is that the Government may be implicated The question is one of missionary control and the conditions on which converts will be admitted to, or allowed to remain in, the Christian churches For some time past, attempts have been made to abolish the practice of clitoridectomy on young girls on the ground that it is a cause of disease and of infant mortality This operation is an essential part of the female initiation ceremonies The missions have made it a rule that no convert or candidate for admission to their churches shall take part in or be a party to female initiation.

THE real bearing of this regulation on the situation in Kenya only becomes apparent when it is realised that without undergoing the operation as a part of the initiatory rite no girl can take her place among the marriageable women of the tribe She ceases to be a valuable asset, no man will seek her in marriage, and the bride-price she would have earned is lost to her family group Hence the missionary prohibition strikes at the roots of tribal organisation and the rights of property and the family The question of the so-called 'obscene' dances and scurrilous songs about persons in authority which the chiefs are trying to suppress on behalf of the Government stand on a different footing The missions are under a serious responsibility in having brought into the political field an issue of such gravity to the whole Kikuyu people However desirable the elimination of the initiatory operation may be, it is not one with which the Government should interfere, at any rate at the present stage of Kikuyu development Would it ever be considered tolerable that any civilised government should interfere with, or place a ban upon, any one participating in the Jewish rite of circumcision ?

THE Archbishop of York scarcely showed Christian spirit in his reference to science students in the newer universities, when speaking on behalf of the Student Christian Movement at York on Feb 27 On account of the large number of students taking science subjects in these universities, the Archbishop is reported in the *Yorkshire Post* to have said, "We are shortly going to be confronted with the peril of a purely scientific education", and he regarded the Student Christian Movement as "the main corrective we have at present to cope with the worst tendency of our contemporary education" He also suggested that students of science as a body are irreligious and without any knowledge of social values, so that "when they come to talk about anything that cannot be measured, anything of civic interest, they talk like children in the nursery" It would be interesting to know the evidence upon which Dr Temple bases his perverted conceptions of science students and of the influence of scientific teaching We have no hesitation in saying that a truly spiritual frame of mind is just as often found among students of science in our universities as it is among arts students, and we can assert with the same confidence that nothing in the teaching of science subverts the highest religious thought or noblest social endeavour The attitude of a student towards these things is largely determined by the influences of his home and school before he proceeds to a university, and the main subjects taken up by him have little to do with it We suggest indeed that, in these days, a purely literary education is a greater peril to progressive life than is the "purely scientific education" which the Archbishop of York regards so fearfully After all, a student of science is not necessarily limited in his reading to technical treatises or in his interests to the laboratory He often takes an active part in spiritual and social movements in spite of what Dr Temple says, and he might reasonably ask for just regard to be shown towards his scientific studies as factors even in a religious life

AT the annual general meeting of the Institution of Mechanical Engineers on Feb 21, the report for 1929 was presented From this it appears that there has been an increase of 279 in the total number of members, which now is 10,745, this being inclusive of 1401 students and 1238 graduates Eighteen papers were presented during the year, and reference is made in the report to the work done by the provincial branches The value of the national certificates granted on the examinations held throughout Great Britain was shown by the increased appreciation of them both by their holders and by employers During the year more than 1200 certificates were issued The council has conferred honorary life memberships upon Dr H S Hele Shaw, who has been a member of the Institution since 1879, and served as president in 1922, and upon Baron Shiba of Tokyo, who has long been associated with the mechanical engineering industry in Japan and took a leading part in the recent World Engineering Congress at Tokyo Mr Loughnan St L Pendred was installed as president of the Institution in succession to Dr D Adamson Born in 1870, Mr Pendred was educated at Finsbury Technical College, and gained practical engineering experience not only in important British works, but also in others in Belgium and France, and in 1896 joined the staff of *The Engineer*, of which his father, Vaughan Pendred (1836–1912), had been editor since 1865 On his father's retirement, in 1905, Mr Pendred succeeded to the editorship, which has thus been held in the same family for no less than sixty five years

AT the same meeting of the Institution of Mechanical Engineers, the sixth report of the Steam nozzles Research Committee was read and discussed The Committee, which was formed in 1914, has for its objects the measurement of the efficiency of nozzles of practical form, and the investigation of the manner in which the efficiency is affected by changes in the shape of the nozzle and by the pressure, velocity, and temperature of the steam passing through it Though delay was occasioned by the War, the work has been carried on continuously since 1921, and the results have been applied with good effect to the design of turbines The sixth report is the final one and is virtually a clearing up of all that has been done, which includes the construction of a testing apparatus for any usual form of steam nozzle with steam flowing at speeds from 300 ft to 2000 ft per second, the measurement of efflux angles, tests of built up impulse nozzles, tests of reaction nozzles, and determinations of the effects of roughness and other points connected with nozzle design The investigations have been carried out in conjunction with the British Electrical and Allied Industries Research Association The results which have been obtained should be of great value to turbine builders

IN a paper on "Pioneer Ships of the Atlantic Ferry", read on Feb 19 to the Newcomen Society by Engr Capt E C Smith, many hitherto unpublished particulars were given of the vessels by which trans Atlantic steam navigation was inaugurated By 1838,

three companies had been formed for the purpose of establishing regular communication between England and America by steam, and in that year the *Sirius*, *Great Western*, *Royal William*, and the *Liverpool* were placed on the route To these vessels were added in 1839 and 1840 the *British Queen* and the *President*, which, like the others, ran to New York, and then came the formation of the Cunard Company and the dispatch of the *Britannia* and her sister ships to Halifax and Boston Of all these vessels, the *Great Western* was the most remarkable, and she continued to run until 1846, making 74 passages in all Tables were given of the voyages of each ship, with particulars of the ships and their machinery and of the relative times taken by the sailing liners and the steamships The *Sirius* and *Royal William* were not built for work in the Atlantic and were soon withdrawn During 1839, however, the *Great Western*, *Liverpool*, and *British Queen* made regular passages and, whereas the outward voyages by sail averaged 33 days, the average time taken by the three steam vessels was only 17 days Of the four pioneer ships built for trans Atlantic work, the *Liverpool* was sold to the P and O Co , the *British Queen* to Belgian owners, the *Great Western* to the West Indian Royal Mail Co , and the *President* in 1841 foundered at sea without anything being heard of her

THE February issue of *Scribner's Magazine* contains the address entitled "Alleged Sins of Science", delivered by Dr Robert A Millikan at the recent meeting at Des Moines of the American Association for the Advancement of Science The address rebuts the charges brought against science by Mr Raymond Fosdick in a recent volume, "The Old Savage in the New Civilisation" "Have we spiritual assets enough to counterbalance the new forces ?" and "Can the old savage be trusted with the new civilisation which he has created ?" are the challenging questions to which Dr Millikan replies Speaking of the sinister possibilities latent in molecular physics envisaged by Prof F Soddy, whereby the equivalent of 150 tons of dynamite could be carried, like a flask of contraband whisky, in the hip pocket of every American citizen, Dr Millikan is able to reassure us that subatomic energy is not likely to be available in dangerous quantities Science, he points out, concerns itself with fertilisers quite as much as with explosives, though as "a horror makes better news than a wheat crop", we hear more about the latter than the former Indeed, science is likely to be effective in abolishing war by doing away with its primary cause, which is a lack of balance between population and food supply "That, in the last analysis, is mankind's greatest problem" Dr Millikan is prepared to admit that in some respects the rapid process of scientific knowledge has created an undesirable mentality in the public Novelties have fostered an omnivorous and quite undiscriminating appetite for what is new, which displays itself in literature in the works of what Mr Stuart Sherman has aptly called the emetic school, and in the experimentalist school in ethics But Dr Millikan has made out a good case for the comparative beneficence of science.

THE Imperial Geophysical Experimental Survey, which has been operating in Australia for nearly two years, under an arrangement between the Empire Marketing Board and the Commonwealth Government, is now finishing its work The leaders of the various sections are at present engaged in Melbourne upon the drafting of their reports, under the direction of Mr A Broughton Edge, leader of the Survey, and Prof T H Laby Electric, gravimetric, seismic, and magnetic methods have been adopted, the object being to test their applicability under Australian field conditions For the most part British instruments have been used The areas examined include Anembo, Captain's Flat, Leadville, and Gulgong in New South Wales , Cooper's Creek, the Mallee, Laverton, Gellibrand dale and Lakes Entrance in Victoria , Chillagoe in Queensland , Zeehan and Renison Bell in Tasmania , Moonta Wallaroo and Port Lincoln in South Australia , and Northampton in Western Australia The governments in all the States have undertaken to test promising indications by drilling and, though there have been delays in certain areas, it is hoped that the results will be available in time for inclusion in the final report

THE areas in Australia selected for the geophysical survey provided opportunity for testing geophysical methods for the location of sulphide ores (lead, copper, and iron), gold deep leads, brown coal, stanniferous pyrrhotites, graphite, and also water horizons (in the Mallee) The results on the whole are decidedly interesting, and are regarded in Australia as thoroughly justifying the survey One outstanding point of interest is the complication introduced by the saline waters which are present at comparatively shallow depths over large portions of the continent In places, electrical methods are of very little value for this reason but the members of the survey have been successful in effecting useful modifications of apparatus by means of which it has been possible to gain results over areas where at first there seemed little chance of success The report will be in two portions, one dealing with the objectives and field results and the other giving much more detailed accounts of theory, apparatus, and field procedure A draft will be submitted to the British Geophysical Committee and the final report will probably be printed and published in England

SIR HUBERT WILKINS, on his return to Montevideo from Deception Island, sent an account to the *Times* of his flight to the south early in February, when he searched in vain for a suitable starting point for a flight to the Ross Sea Travelling south west in the *William Scoresby*, lent by the Falkland Islands government, he met the pack ice about thirty miles south of Peter Island Weather conditions were bad, but the seaplane was launched on Feb 1 in about lat 70° S , long 100° W (the figure of long 145° given in the report is clearly a mistake) The weather became worse , visibility was very bad In lat 71° S it was noted that the edge of the pack spread westward In a position which Sir Hubert believes was about lat 73° S , long 101° W , he saw no indication of land or

barrier ice, but a number of large bergs, and much pack ice From there the flight was directed back to the ship, which then set a course for Deception Island, sounding and trawling on the way These observations will amplify the work done by the *Belgica* in those seas in 1898–99 on a course slightly farther in the north Sir Hubert Wilkins believes that a meteorological station might be established in about long 100° W by seaplane, but it would be difficult He does not think a sea going ship could hope to reach land and land ice in that area, but suggests that a submarine might well be utilised

THE occurrence of a spell of summer like warmth over the eastern parts of the United States was reported on Feb 25 last in the daily Press Among the more notable maximum temperatures quoted were one of nearly 84° on Feb 24 at Washington, and of 75° at New York on the same day The weather charts for the northern hemisphere published daily by the Meteorological Office, based on observations made at 8 P M (American time) at the official stations of the U S Weather Bureau, confirmed the occurrence of very exceptional conditions, and an examination of successive charts give some idea as to their immediate cause Over the temperate latitudes generally, the slope of temperature from south to north is sufficiently steep to make the occurrence of unseasonable warmth at a time of the year when the direct heating by the sun is small merely a matter of transport of air from low to relatively high latitudes This must happen when the run of the isobars is from south to north over a wide area for several days in succession, as was the case over the eastern part of the United States for several days before Feb 25, for the general drift of the wind in the lower layers of the atmosphere is in accordance with the direction of the isobars

A MAXIMUM of 75° has not occurred at New York in February during at least forty eight years, the previous highest having been 69° The exceptional feature on the weather charts during this 'heat wave' in the United States was the length of the trough of low pressure that provided the southerly winds, there are not sufficient observations to show whether it extended as far as the equator, but the northern shores of the Gulf of Mexico experienced such winds for several days, with a rising temperature that yielded at least one 8 P M reading so high as 80°, and this is scarcely likely to have happened unless the winds extended a long way farther south In the opposite direction, the same air stream appears to have continued without a break to the neighbourhood of southern Greenland and Iceland, where it was deflected into the south westerly wind characteristic of those regions

THE Air Ministry announces that in consequence of the rapid development of the international organisation for the collection of weather reports, it has been possible for some months past to prepare each day in the Meteorological Office, London, a chart showing the weather for the greater part of the earth's surface north of latitude 40° N At first, copies of this chart were prepared by a cyclostyle process for use in the Meteorological Office, but demands for copies became so large that it was necessary to arrange for them to be lithographed, this chart has, however, never been made generally available to the public The importance of this chart to everyone interested in the weather is so great that it has been decided to issue it daily as part of the *Daily Weather Report* This has necessitated a rearrangement of the matter printed in the *Report* and an increase in the size of the sheet, which now becomes 13 in × 12½ in When the new *Report* is opened out, the left hand half shows a weather chart of the British Isles with forecasts, general inference and further outlook This page also contains the data from health resort stations The right hand half shows the new chart of the northern hemisphere with the north pole slightly displaced from the centre of the sheet, thus allowing North America, Europe, North Africa, and northern Asia to be included The two back pages contain the complete set of observations made at the telegraphic reporting stations in the British Isles four times each day, namely, 1 A M, 7 A M, 1 P M, and 6 P M, with a large amount of miscellaneous information and full explanation of the symbols used The opportunity has been taken of improving the general appearance of the *Report*, the land areas now being printed in buff colour, and the weather information overprinted in black The new *Daily Weather Report* came into use on Mar 1, and may be obtained from the Meteorological Office, Air Ministry, Kingsway, London, the price being 1½*d* for single copies, or 6*s* 6*d* a quarter, or 25*s* a year, post free

PROF G I TAYLOR's Friday evening discourse at the Royal Institution on Feb 28 took the form of an account of his tour in the East Indies after attending, as a British delegate, the Pacific Science Congress held in Java last year During and after the Congress the Government of the Netherlands Indies provided every possible kind of hospitality and opportunity for seeing their countries The journeys described were illustrated by means of films taken by a small cinema camera The first film showed a visit which some members of the congress paid to Krakatau In 1883 this island was the scene of the greatest volcanic disturbance ever recorded Extensive researches have shown that all animal and vegetable life was then completely destroyed, and the successive stages of their gradual reappearance have been of great interest to botanists and zoologists At the present time, quite large trees have established themselves and the film showed a stage in which the *Casuarina* trees are already being suffocated by huge creepers A visit to a small island called Suak Krakatau which appeared mostly in 1928 was of interest, because a few weeks after the film was taken the island disappeared Two further films illustrated a journey in Borneo by river and jungle from Dutch territory to Sarawak This journey was undertaken by Prof Taylor and his wife, by the kind and efficient help of H H the Rajah of Sarawak and of Dutch officials The film showed the journey up the Kapoewas River, the trek through the jungle with a party of Dyaks, and an

impromptu dance by one of them at a resting-place in the jungle The end of the film showed the descent down the Lupar River in a long dug out canoe paddled by Dyak boatmen and a visit to a Dyak kampong

Members and friends of the Manchester Microscopical Society, which was founded in 1880, met for a jubilee reunion on Feb 20 at the rooms of the Literary and Philosophical Society An address by Prof S J Hickson, who was unavoidably prevented through illness from attending, was read by the president, Dr John Walton, lecturer in botany at the University of Manchester Prof Hickson chose for his subject "Biology and Beauty", and developed the idea that, in opposition to the older classical view of education, there is in the study of biology, and especially in the intricacies of the technique required, a distinct cultural and æsthetic value which has a refining influence and is a strong incentive to further work and research, while the utility of biology is every day becoming more apparent Of four living past presidents only one, Prof Weiss, was able to be present The Society, the largest of its kind outside London, can look back with satisfaction on its unbroken half century's work, from its beginning it has counted in its ranks those who might find themselves in everyday life classified as employers and employed, but who meet on terms of equality united by a common interest in biology and microscopical science The Society includes among its members professional scientific workers as well as those to whom science affords a recreation after their usual daily occupations It has also had strong support from members of the University, in the laboratories of which many of its exhibitions have been held In these days, with so many applications of the microscope in industry, the Manchester Society can look forward with confidence to a new era of usefulness

The Kampala correspondent of the *Times* announced recently (Feb 20) that a gorilla sanctuary has been proclaimed in the south west corner of Uganda in the neighbourhood of the Sabinio mountain and the Belgian Congo border This rounds off the gorilla territory, of which a portion had already been proclaimed a sanctuary by the Belgian Government, and, if adequately watched, should afford a safe retreat for many generations to come for one of the closest of man's surviving relatives

Sir Thomas H Holland, Vice Chancellor of the University of Edinburgh, has been awarded the Gold Medal of the Institution of Mining and Metallurgy "in recognition of his eminent services to Geological Science and to the mineral industries during his tenure of high public appointments—notably those of Director of the Geological Survey of India and of Rector of the Imperial College of Science and Technology —and of his researches and publications upon the mineral resources of the British Empire and their relationship to national and international problems"

At a general meeting of the members of the Royal Institution, held on Mar 3, it was announced that the managers have elected Mr J B S Haldane Fullerian Professor of Physiology in succession to Prof J S Huxley. The Friday evening discourses after Easter will commence on May 2, when Mr H E Wimperis will give a discourse on "A Study of the Phenomenon of Spin in Airplanes" Successive discourses will probably be given by Prof J Garstang, Dr C M Yonge, Mr R S Whipple, Sir Harold Carpenter, and Prof H Clay

At the ninth annual dinner of the London section of the British Association of Chemists, held on Mar 1, Sir Arnold Wilson outlined a scheme which is now under consideration for a building to house the principal societies and institutions in London concerned with chemistry and chemical industry or related to them The societies interested are the Institution of Mining and Metallurgy, the Institution of Mining Engineers, the Chemical Society, the Society of Chemical Industry, the Institution of Chemical Engineers, the Institution of Rubber Industry, the Institution of Petroleum Technologists, the Institute of Fuel, the Institute of Metals, the Iron and Steel Institute, the Faraday Society, and the Physical Society It is proposed that all these societies should be housed under one roof and their libraries pooled for the common use of their members As Sir Arnold pointed out, the scheme has the advantage that each society would retain its own individuality while giving its members facilities for informal meeting with members of related societies It would thus be an important step towards the co operation and co ordination so necessary to day in allied branches of science and technology It was stated that £100,000 has already been promised in furtherance of the scheme

At a meeting of the Royal Society of Edinburgh held on Mar 3, the following were elected fellows of the Society Prof William Annan, Edinburgh, Mr D R R Burt, Colombo, Lieut Col John Cunningham, Edinburgh Lieut Col L M Davies, Edinburgh Dr A E M Geddes, Aberdeen, Dr Douglas Guthrie Edinburgh, Sir Thomas Holland, Edinburgh, Dr David Jack, St Andrews, Dr S G Jones, Glasgow, Prof P S Lelean, Edinburgh, Dr J W Low, Bristol, Dr A C M'Candlish, Sorbie, Mr W C Miller, Edinburgh, Dr J M W Morison, Edinburgh, Mr James Morton, Edinburgh, Prof Wm Oliver, Edinburgh, Principal G F O'Riordan, London, Mr A W Ritchie, Edinburgh, Dr David Russell, Leven, Dr F W Sansome, London, Mr E C Shankland, London, Dr R H Slater, Edinburgh, Mr J W Struthers, Edinburgh, Prof C W Stump, Sydney, Dr J D Sutherland, Edinburgh, Dr C I B Voge, Edinburgh, and Dr A C White, Beckenham

The Empire Marketing Board has made a grant to the New Zealand Department of Scientific and Industrial Research for research on fruit production and storage to be carried out in New Zealand Investigations will be pursued into cool storage, transport, disease and insect control, nutrition, physiological disturbances, and rootstock propagation of New Zealand fruit Valuable results have been obtained in the past, as the quality of fruit imported into Great Britain shows, but the work has suffered from lack

of continuity and field experiments At a conference held recently at Wellington between representatives of the fruit-growers, the Department of Agriculture, the Department of Scientific and Industrial Research, and the Cawthron Institute, it was decided to form a fruit research organisation for New Zealand Arrangements have been made to purchase an orchard, a research programme has been planned, and the Cawthron Institute and the Department of Agriculture have agreed to lend the members of their staff who are mainly engaged on fruit research A horticulturist is to be appointed to work on root stock improvement and introduction, and it is probable that he may first study methods and results achieved in Great Britain at the East Malling Research Station, where Mr R G Hatton is engaged on root-stock improvement and other activities with Empire Marketing Board funds New Zealand fruit growers are contributing substantially to the expenses of the scheme, and the remainder of the cost is being met by the New Zealand Government

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —An engineer at the Building Research Station, Garston, near Watford, for work mainly in connexion with research on steel structures—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S W 1 (Mar 10) A public analyst for the City of London (Food and Drugs (Adulteration) Act, 1928) and agricultural analyst for the City and Port of London (Fertilisers and Feeding Stuffs Act, 1926)—The Town Clerk, Public Health Department, Guildhall, E C 2 (Mar 10) A lecturer in chemistry at the Widnes Municipal Technical College —The Clerk to the Governors, Municipal Technical College, Town Hall, Widnes (Mar 17) A woman sanitary inspector and health visitor for the Royal Borough of Kensington—The Medical Officer of Health, Town Hall, Kensington, W 8 (Mar 18) A resident lecturer in geography at the Diocesan Training College for Women Teachers, Derby—The Principal, Diocesan Training College for Women Teachers, Derby (Mar 21) An assistant on the higher technical staff of the Library in the Science Museum, South Kensington—The Director and Secretary, Science Museum, South Kensington, S W 7 (Mar 22) An organiser of agricultural education under the Administrative County of Cambridge—The Clerk of the County Council, County Hall, Cambridge (Mar 22) A lecturer in metallurgy at the University College of Swansea—The Registrar, University College, Singleton Park, Swansea (Mar 28) An assistant to the Chief Officer of the Imperial Bureau of Fruit Production—The Chief Officer, Imperial Bureau of Fruit Production, East Malling Research Station, East Malling, Kent (Mar 31) An assistant lecturer in geography in the University of Birmingham—The Secretary, The University, Birmingham (April 26) A professor of zoology in the University College of North Wales—The Registrar, University College of North Wales, Bangor (May 5) A secretary to the Lagos Executive Development Board, Nigeria—The Crown Agents for the Colonies, 4 Millbank, Westminster, S W 1 (quoting M/2029) A sanitary inspector under the Sudan Medical Service—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S W 1

Our Astronomical Column

Report of the Paris Observatory for 1928 —This report contains an interesting summary of the recent comparison of longitudes of various observatories by wireless signals, which was organised by M B Baillaud and General Ferrié

The following are three arcs girdling the world

Algiers to San Diégo	8^h	0^m	56	$900^s \pm 0\ 002^s$
San Diégo to Zi Ka Wei	8	5	28	$731 \pm 0\ 006$
Zi ka Wei to Algiers	7	54	34	$362 \pm 0\ 006$

The sum of the three shows an error of only 0 007 sec

The difference Paris Greenwich comes out $9^m\ 20\ 914^s$, which is less than the "Nautical Almanac" value by only $0\ 016^s$ There was formerly an appreciable difference between the English and the French determinations of this arc, but they have now been brought into satisfactory accord

The catalogue of 10656 "étoiles de repère" for the Astrographic Catalogue is on the point of being issued

Dark Objects in Barnard's Photographic Atlas — In a fifth note on the dark objects in Barnard's Photographic Atlas, published in the *Atti della Pontificia Accademia della Scienze* (*Nuovi Lincei*) for 1929, Prof G Hagen of the Vatican Observatory points out that the last ten plates in Barnard's Atlas confirm the suggestion of the preceding forty plates, that not a single one of the dark objects selected by Barnard for his two lists differs in any way from W Herschel's fifty two extensive nebulosities Moreover, all of those within reach of the Vatican refractor could be estimated in density on the numerical scale with which all Herschel's regions were examined It may safely be concluded that all the dark markings represented on the fifty plates of the Atlas, whether selected or passed over by Barnard, correspond with the Herschel regions

Distribution of Stars of Different Spectral Types — Dr Otto Seydl of Prague has published a series of maps which give the distribution of stars of the different spectral types referred to galactic co ordinates The stars of types *B*0 to *B*5 are confined to a narrow belt along the galaxy Those of *B*8 to *A*3 are in a wider belt, with a few islands in higher latitudes, in the next map, *A*5 to *F*2, the galaxy is still discernible as a richer region, but there is a strong minority in higher latitudes, the same description applies to the next two maps, *F*5 to *G*0 and *G*5 to *K*2 For *K*5 to *Mc*, galactic concentration is again strongly in evidence, but less so than in *B*0 to *B*5 There is a final map showing all types combined, naturally the whole map is fairly full, but the galaxy is by far the richest region Star density is indicated by depth of shading in the manner adopted to show ocean depths The Henry Draper Catalogue was used in preparing the maps, which include stars of magnitude 7 0 and brighter There is a description (in English) of the maps, together with tables, the whole forms Cis 6 of the *Publications* of the National Observatory of Prague

Research Items.

Pictographs on European Prehistoric Pottery.—We have received from Dr. L. A. Waddell a questionary on the Sumerian markings upon prehistoric pottery found in the Danube and associated valleys of Middle Europe. In an explanatory note Dr. Waddell appeals to archæologists and historians in middle and south-eastern and northern Europe, and particularly to prehistorians in the British Isles, to examine all examples of prehistoric pottery from the area mentioned to which they have access for markings, apart from the decorative element, in the nature of owner's or maker's marks. The object of the search, it is explained, is to demonstrate that these markings are analogous to the 'owner's marks' inscribed on the pottery of the Predynastic and First Dynastic periods in ancient Egypt. The latter, Dr. Waddell maintains, can be shown to be Sumerian pictographic writing and presumably bear their phonetic values. By means of a comparative table of marks, Dr. Waddell seeks to demonstrate their identity in Sumerian, Egyptian, and Danubian pottery marks, giving their phonetic equivalent in each case. Dr. Waddell also holds that he has demonstrated that all the ancient civilisations of the world—Mesopotamian and Elamite, Egyptian, Minoan, Hittite, Græco-Roman, Indo-Persian, and presumably also Chinese, were derived from Sumeria. By a synchronism of ancient Egypt and Mesopotamia, Menes is identified as a son of Sargon of Akkad and his date fixed at about 2703 B.C., while for the Danubian pottery from the prehistoric strata at Vinča, a date of about 3300 to 2700 B.C. is suggested on palæographic grounds.

Sacred Trees in Egypt.—In *Man* for January, Mr. G. D. Hornblower describes with photographs a sacred grove at Nezlet Batran in Egypt, which differs from most sacred groves in that country in that it is not connected with any holy personage. Sacred trees, mostly sycamore, are common in Egypt, normally in association with sheikhs or their tombs. On them rags from the clothing of their devotees are frequently hung. The Virgin's Tree at Matarieh, near Cairo, is a well-known example and has been the object of pious pilgrimage for Christians for centuries. Under it the Virgin is said to have rested with the Holy Babe, and here only was true balm grown, originating in water from the Infant's clothes which the Mother washed out in a neighbouring pool. The grove at Nezlet Batrân is known as *Dahr es Sunt*, "The Back of the Acacias." The fact that it is not associated with a Moslem or Christian saint suggests that here the belief has survived from very early times in considerable purity. It is sacred to the *Sukkan es Sunt*, "The Inhabitants of the Acacias"—supernatural beings who live underground. It is visited on Friday mornings, and its leaves dried and powdered are burned as incense for the healing of the sick. No man may use its wood for fuel under penalty that evil, such as fire, will strike his house or he may lose his cattle through sickness. It shares with other sacred trees two features. Lighted lanterns are hung on the branches, and iron nails are driven into the trunk as offerings for sick people. These must be fresh from the forge.

Biological Control of the Gipsy Moth.—In *Technical Bulletin* No. 86 of the United States Department of Agriculture (1929) Messrs. A. F. Burgess and S. S. Crossman discuss the results of twenty-four years of work with reference to this problem. Both the gipsy moth and the brown-tail moth are well-known introduced pests of the United States and the present report reviews the work done in controlling these insects by the introduction of their natural enemies from Europe. It is claimed that by introducing insect parasites against the gipsy moth, the forests of New England have been saved from destruction. From 1905 to 1916 defoliation showed no reduction in intensity, but, from 1920 to 1924, the acreage defoliated gradually decreased, until in the latter year few completely defoliated areas remained. The total percentage parasitism resulting from the activities of beneficial insects gradually increased until the maximum was attained in 1923. Since then, the parasitism has steadily declined until 1927, when some revival was noticed. The authors state that unless the parasites increase again more rapidly, the westward spread of the gipsy moth will have greatly reduced chances of being checked. During the decline of the parasitism the gipsy moth has greatly increased again and, in eastern Massachusetts, it regained its former severity. In forest areas, where artificial control methods, other than the elimination of favoured food plants, are not applicable, the sole chance of repression, without undue expense, lies in biological means. Much work still remains to be done on the latter procedure, and investigations being made in the native countries of the gipsy moth lend support to the possibility that improved methods and results will follow. In towns and cities, on the other hand, artificial control, although expensive, can be employed and yields good results. A combination of both methods of campaign, according to the type of country in question, requires continued rigorous prosecution.

Pliocene and Pleistocene Fossils from Sakhalin.—The northern half of the island of Karafto, or Sakhalin, has long been known to yield rock oil in the regions bordering on its eastern coast. During the occupation of the island by the Japanese, regular surveys of these districts were made and fossils collected, many of which, however, were destroyed in the fire following the great Tokyo earthquake of 1923. The remainder, with some additional material and specimens collected farther south, where oil does not occur, have now been described by Prof. Matajiro Yokoyama (*Jour. Fac. Sci., Imp. Univ. Tokyo*, sect. 2, vol. 2). Forty-two species of marine mollusca are described and referred to the Pliocene, while a few from the southern locality are ascribed to the Pleistocene. From a study of these the author is led to infer that whereas in similar deposits in Japan proper and in Formosa the evidence, as pointed out in previous papers, indicates a colder climate then existed than at the present day, no such difference seems to have occurred in Sakhalin. Further studies on this point are nevertheless necessary.

After-Shocks of the Tango (Japan) Earthquake of Mar. 7, 1927.—Mr. N. Nasu, of the Tokyo Seismological Institute, has recently made an exhaustive study of the after-shocks of the Tango earthquake (*Jour. Fac. Sci., Tokyo Imp. Univ.*, vol. 3, pp. 29-129; 1929). These shocks were so numerous that at one station 1307 shocks were recorded up to the end of June 1928. Of these it was found possible to determine the surface position and depth of focus of 482 shocks. The sites of the shocks changed from time to time within a limited area near the two new faults, the most active zones lying to the west of the Gomura fault, and to the south of the Yamada fault. From the distribution of the epicentres, it is inferred that the Gomura fault may extend under the Japan

Sea to a distance of 18 miles from the coast, so that its total length may be more than 30 miles, while that of the Yamada fault may be 18 miles Plotting the positions of the foci on horizontal and vertical planes, Mr Nasu shows that they lie on series of parallel planes from one to three miles apart, the sensible shocks being caused by the formation of large cracks, and the insensible shocks as a rule by the growth of small secondary cracks that were very numerous near the principal faults A clinograph, erected near the central region of the earthquake, showed that the ground tilted for a few days before each after shock of moderate strength, the tilting being towards or from the epicentre according as it lay in a region of subsidence or elevation during the principal earth quake

Samarskite from New Mexico —A detailed study of the samarskite from a mica pegmatite near Petaca in the north central part of New Mexico has been made by F L Hess and R C Wells, and their results are published in the January number of the *Amer Jour Sci*, 1930 The mineral is shown to be composed of two parts one approximating to $2Y_2O_3$ $3Cb_2O_5$ and the other to Y_2O_3 Cb_2O_3 Detailed analyses are given from which the following data are quoted

	I	II
U	10 66	4 85 per cent
Th	1 39	0 97 ,,
Pb	0 40	0 10 ,,
$\frac{Pb}{U + 0\ 38\ Th}$	0 038	0 019
Age	280	140 millions of years

Radiographs show that I is an older mineral which was partly replaced by II by later solutions flowing along cracks The results indicate that the variable results in age calculations on minerals from the same pegmatite are due to successive periods of mineralisa tion The evidence supports the thesis of Hess that many pegmatites are the product of successive re placements, and it further explains satisfactorily the puzzling fact already recognised by Holmes, Ells worth, and Kirsch, that minerals from the same petrographic province may show very different ages as tested by their lead ratios It is suggested that the radial cracking of pegmatite around minerals may be due to the growth of new minerals being faster than the replacement of the older material

The Behm Limno-Sounder —A useful echo sounding machine for use in shallow water from small craft, such as motor boats and rowing-boats, is described in the *Hydrographic Review*, vol 6, No 2 The Behm Limno Sounder is operated with 12 volts, and power is supplied from dry cells or a storage battery It is made of light metal, and has a range up to 200 metres, and shows the depths in metres When the vessel is stopped, the range is greater than when the vessel is under way Soundings may be repeated at intervals of a little less than one second The transmitter and receiver may be permanently fixed to the vessel's side or bottom, or, if more convenient, may be slung over the side by a rope when required The depth is shown by the reflection of light A point of light moves along the scale, and the length of the line of light is the measure of depth The same apparatus mounted on a tripod is adaptable to soundings from an ice covered sea or lake Its operation is unin fluenced by low temperatures A special form of this sounder lowered by a cable and provided with floats could, it is claimed, be used from an airship

Surface Tension and Temperature —In the issue of the *Physikalische Zeitschrift* for Jan 1, Dr N Bar bulescu, of the Physical Chemistry Laboratory of the University of Klausenburg, Rumania, sums up and extends his endeavours to express by a satisfactory formula the variation of the surface tension α of a liquid with temperature He introduces the idea of a surface tension of the gas or vapour above the liquid and makes the observed surface tension the difference between the true surface tensions of liquid and gas or vapour It is also assumed that it varies as exp $-a/(T_c - T)$ where a is a constant and T_c the critical temperature of the liquid On these assumptions, he arrives at the relation $\alpha V^{2/3}$ pro portional to $(T_c - T)$ exp $-a/(T_c - T)$, which he shows fits the observed values very well for a number of normal liquids, except close to their critical points For abnormal liquids he makes a a linear function of $T_c - T$ and states that a still more accurate expres sion $\alpha V^{2/3} = (A + BT + CT^2)(1 - p/P)$ where A, B, and C are constants, p the saturation vapour pressure at T and P at T_c, may be used up to the critical point

Range of Electromagnetic Waves —Mr V T Saunders has prepared a chart, based upon one ex hibited by the Royal Society at the British Empire Exhibition at Wembley, showing the range of electro magnetic waves (size 6 ft × 1 ft 10 in (London John Murray, 1930) Unmounted, 4*s* 6*d* net, mounted on linen, 8*s* 6*d* net, mounted on linen, folded, 10*s* 6*d* net, mounted on linen, varnished, on rollers, 12*s* 6*d* net) The chart covers the whole range of the electromagnetic spectrum between the cosmic rays and the waves produced by mechanical movement of a coil in a magnetic field Wave lengths are shown both in centimetres and in Ångström units, together with the corresponding frequencies, and summaries are given of how the waves in each range are generated and detected There are two errors under the head of the detection of X rays It is not necessary for a body to be heated for it to emit electrons under their action (*e*), and it is at least mis leading to state without further detail that X rays show no ordinary reflection or refraction (*f*) Apart from these two points, the chart is accurate, and is likely to find a home on the walls of most elementary laboratories

Rapid Chemical Changes —The February number of the *Proceedings of the Royal Society* contains two papers by Dr F J W Roughton on heat effects in rapid chemical changes The time required for com pletion of a reaction is often a very small fraction of a second, if the reacting materials are in good contact, and the measurement of this time, or the setting of an upper limit to it, especially if coupled with a deter mination of the thermal effect, calls for a special technique Dr Roughton has applied for this pur pose a modification of the method used by him and Dr H Hartridge for studying the velocity of rapid reactions, the reagents are mixed whilst travelling at high speed through an observation tube, and the temperature of the mixture read at various points by delicate thermocouples, time intervals being deduced from the speed of flow of the fluid After an ex haustive inquiry into the possible sources of error, Dr Roughton concludes that it is possible to measure absolute temperatures in the mixture to an accuracy of 10^{-3} deg C, and temperature differences to somewhat less The order of magnitude of the time intervals involved is indicated by his result that the total heat of neutralisation of most acids and bases is liberated within a period of less than one hundredth of a second Attempts are now being made to extend the accuracy of the temperature measurements to 10^{-4} deg C, which will permit of the study of some reactions of considerable physiological importance

Gramophone Records of Acoustic Analyses.

AT a meeting of the Physical Society of Sheffield held at the University of Sheffield on Feb 11, a number of special gramophone records prepared in the Bell Telephone Laboratories, New York, to illustrate certain phenomena of hearing, were demonstrated by Dr W H George In the preparation of the original records the usual electrical process was used to convert the sound-waves by means of a microphone and amplifier into fluctuating electrical currents which, in passing through an electromagnetic recorder, operate the stylus cutting the 'wax' In addition, electric filters could be switched into the circuit so as to eliminate effectively known frequency ranges

Three of the records demonstrate the striking discovery of Fletcher (*Phys Rev*, 23, p 427, 1924) that, contrary to the usual conception, the pitch of a musical sound is *not* necessarily that of the lowest component vibration A single note (C = 256 vib per sec) is played successively upon a piano, a 'cello, and a French horn, and then the notes are repeated with the filters adjusted to eliminate the fundamental tone, then the fundamental and the first two overtones, and later all below the sixth or eleventh overtones Although great differences in quality and intensity are apparent, the pitch of the notes heard remains the same Quality differences sometimes make it difficult to decide if the pitch is middle C or one of its octaves The experiments and results are repeated with the sung vowel Ah, with an organ pipe and with a clarinet, in which latter instrument the lower even overtones are very weak

Low pass filters are used in another record to illustrate the effect on tone quality of removing the upper partials from the tones of a single note played upon a piano, 'cello, or French horn The filters are adjusted to give successively the fundamental, and then no overtones above the first, fourth, ninth, and seventeenth Notable changes of quality and loudness are observed depending upon the relative intensity of the various overtones for each instrument When the fundamental only is recorded the instruments are almost indistinguishable, but the slight difference which remains when allowance has been made for the intensity differences and for a certain difficulty of the horn player getting the correct note, suggests that the quality of a musical note depends also upon the rate of growth and decay, and it would be interesting to hear the effect of various amplitude changes imposed upon a tone which when sustained was pure and of single frequency

The remaining records deal with the quality changes produced in much more complex sounds consisting of a short musical passage played by a number of instruments and with a passage spoken by the normal voice The original sounds cover a normal range of frequencies, and the filters introduced pass only the frequency ranges 375 2500 or 750 1250, below 1250 or 2500 or above 375 or 1250 vibrations per second The effects of an overloaded amplifier with and without a middle pass filter are illustrated and the characteristic high hissing sound appears well in the spoken passage Filters are not used in two of the records which demonstrate the effects of reductions in the general intensity of the same complex sounds The intensity level is lower by steps of 1, 3, 5, 10, 20, and 30 transmission units (or decibels) Incidentally, these two records enable the hearer to obtain an idea of the scale of this unit which is being generally adopted

Apart from the general interest of the records, it would appear that, provided we regard a good gramophone as fairly common, then the three records illustrating Fletcher's work on perception of pitch form the first example of a research worker in acoustics presenting results originally obtained with complex and expensive apparatus in such a form that the actual phenomena involved can be experienced by others not so equipped The records may then be regarded as the analogues of the spectrum or X-ray photographs presented in papers dealing with other branches of physics

Common Commercial Timbers of India and their Uses

THE technical publications of research institutes have rarely much attraction for the layman, nor are they commonly read by members of trades to whom they would prove useful With this truism in mind, Mr H Trotter, forest economist at the Forest Research Institute at Dehra Dun, has recently prepared a brochure entitled "The Common Commercial Timbers of India and their Uses" (Calcutta Government of India Central Publication Branch, 1929), designed for the use of timber merchants and other users of Indian timbers

This booklet is based, as the author admits, on one drawn up in 1912 by his predecessor, Mr R S Pearson, entitled "A Commercial Guide to the Forest Products of India" Mr Trotter's work shows the great advance in knowledge in these matters which has been made since 1912 In the preface the author states "A great deal has been written of late years concerning the 'vast forest wealth' of India The fact remains, however, that except for teak and a few parcels of other timbers from Burma, Madras, and the Andamans, there is practically no export of timber from the country In the same way, the Indian markets concentrate on teak, sal, deodar and a few other well known woods, while local craftsmen content themselves with the cheapest timber available, whether suitable for the purpose for which it is intended or not"

Two factors are bringing about a change in the conservative ideas which have so long persisted throughout India The first is the prohibitive prices to which the more commonly used valuable timbers have risen, the second, the valuable work carried out at the Research Institute during the past eighteen years As is obvious from his work, Mr Trotter regards the forest wealth of India from the purely timber point of view Writers with perhaps a wider experience when alluding to the "vast forest wealth" of the country have not been so limited If some of the most valuable timbers of the country were eliminated from the account, the value of India's forest wealth, regarded from the point of view of the requirements of the greater bulk of its population, would still be enormous, and to this may be added an increasing number of minor products of the forest the potential value of which is at present not computable

The author divides his work into several chapters, dealing with the storage of logs in log ponds (the method being described and illustrated); air-seasoning —a section which will well repay careful study—kiln seasoning, preservation of timber by impregnation, and a chapter describing various common Indian woods This latter chapter is of importance, since, from the experience gained at Dehra Dun, it has proved possible to modify some of the descriptions

in old text books of Indian timbers, for example, Gamble's "Manual of Indian Timbers"

The practical user of timber, as also the forest officer, will probably find Chap vi, "Woods recommended for Special Uses", of the highest interest It is certain that this chapter best illustrates the remarkable progress in our knowledge in these respects which has resulted from the work of the research institute at Dehra Dun The author points out that there is a wide range between the cork like wood of *Erythrina* and the iron like hardness of 'pyinkado', and that only research and trial will enable each timber to be allotted to its best purpose, this is the work the economic side of the Institute has been engaged upon "As the work of research proceeds, it becomes more and more evident that India possesses timbers which are unsurpassed by any other country, but the practical utilisation of the lesser known timbers has been hindered by a curious circumstance This circumstance can be summed up in the one word 'teak' For years past, teak has been the watchword in India It is what one might call a fool proof wood, and its durability and adaptability soon made it famous throughout the world With such a timber available in good quantities, Indian users looked no further for possible substitutes, until the inevitable began to happen, and supplies became more restricted, resulting in a very rapid rise of price Then, at last, India began to look to the rest of her timbers, and although considerable progress has been made to date, it will be some years yet before she knows exactly what her resources in this direction are, and still more time will be required before the industrial world is satisfied that these other timbers will answer the purpose for which they are required In addition to teak, such timbers as sal (*Shorea robusta*), deodar, chir (*Pinus longifolia*), sissoo (*Dalbergia sissoo*), and a few others, were used fairly extensively in those parts where they occurred, but beyond these, the commercial exploitation of the many hundreds of other so called Indian 'junglewoods' was a thing unknown"

The author divides this section into constructional woods, woods used in contact with the ground, woods used in contact with water, in boat and ship building (the best Burma teak known as 'Admiralty Teak' still reigns supreme), joinery and cabinet making (a number of species are enumerated), cart and carriage-making, cooperage, packing cases, and various miscellaneous articles A perusal of this chapter renders it evident that India could, and probably will, become entirely self supporting in articles the raw material of which is timber, and that in the future the people will be weaned from the old ideas which confined utilisation to teak, sal, deodar, and one or two others, for this chapter shows that already a variety of other Indian timbers are being brought into use

Mr Trotter is to be congratulated on a very valuable and useful piece of practical work which, *du reste*, is suitably illustrated

Larval Crabs

An important addition to our knowledge of development in the Brachyura is contained in Hiroaki Aikawa's recent work "On Larval Forms of some Brachyura" (*Records of Oceanographical Works in Japan*, vol 2, No 1, 1929) The author has hatched out the young of twenty four species of Japanese crabs, and from these first zoeas each genus can be quite easily recognised

Previous writers have used mainly the form of telson, presence or absence of spines on carapace, and the antennæ, as diagnostic characters of crab zoeæ, and those hitherto known can be classified by such characters, together with a knowledge of the number of zoeal stages The present author gives prominence also to the chromatophores, giving them a foremost place There is no doubt that these chromatophores are of importance, the disadvantage in using them is their comparatively fleeting nature Although Mr Aikawa states that the primary chromatophores (which alone are used) remain for a long time in preserved material, they undoubtedly do disappear eventually Taken together with the other characters, however, they are of considerable value

The system of classification given, based on the first zoeas only, is good, and shows that the Japanese crabs studied fit well into the usual scheme of classification It is to be hoped that further study will be made of the later stages and megalopæ A knowledge of these, together with number of zoeal stages, is much wanted The Oxyrhyncha having been shown in all known forms (with a few doubtful exceptions) to have only two zoeal stages, necessarily develop much more quickly than the Brachyrhyncha, and even in the first zoea this difference can be seen

The crabs described belong to various groups and families most of the larvæ being described for the first time, and the first zoea is in many cases compared with those from other countries, fitting in well with previous observations If such a study were to be made in all parts of the world we should have a real foundation on which to work in order to form a scheme of classification which would undoubtedly help the systematist for no systematic work can be complete without the thorough knowledge of all larval stages The paper is very well illustrated and is a welcome contribution to the literature on crustacean larvæ

University and Educational Intelligence

BIRMINGHAM —Dr J G Emanuel is to be invited to fill the vacancy in the joint professorship of medicine from the beginning of the summer term 1930

The following gifts have been received £350 from the Distillers Company, Ltd, for a post graduate research investigation in oil engineering, £100 from the Anglo Persian Oil Company and £100 from the Institute of Automobile Engineers, for research in oil engineering, mine rescue apparatus to the value of £210, from Messrs Siebe, Gorman and Co, and a collection of modern safety lamps, to the approximate value of £77, from several firms, for the Mining Department Mrs Frankland has presented to the Chemistry Department a bronze relief portrait of Prof P F Frankland, first professor of chemistry in the University

The following resignations have been received Mr T H Turner (lecturer in metallurgy), Mr L P Timmins (oil engineering), and Dr W C O Hill (anatomy) An additional assistant lecturer (Grade III) is to be appointed in the Department of Geography

EDINBURGH —The Court has agreed to subscribe to the Students' Hostel at Benmore, Argyllshire This Hostel, which was formerly the Mansion House of Benmore, has been presented to the Forestry Commission (Scotland) by Mr Harry Younger, who had previously given the whole estate to the Commission The house will be open to visiting students and members of scientific societies interested in sylviculture and botany from April 1 to Sept 30 in each year The policies, extending to 115 acres, including the gardens and arboretum, will be open to authorised visitors In addition, the adjoining and neighbouring estates

of the Forestry Commission, extending to 36,000 acres, will be available of access for educational purposes

Leeds —The University Council has recorded "its profound regret in the loss sustained by the death of Arthur Greenhow Lupton, the first Pro Chancellor of the University His long and continuous association with the Yorkshire College and University—a connexion unbroken for 55 years—lent to his counsel a supreme value, and to his advice the wisdom born of experience He had followed and accompanied every step in the growth of the Yorkshire College, and its gradual development to University status He presided over the board of Governors of the College from 1889 till 1904, and over the University Council from 1904 till 1920 The University acknowledges with pride that the distinguished place and high standing which it now occupies in the public opinion of Yorkshire and the country are in large measure due to the character and ideals of its first Pro Chancellor "

London —Dr H A Harris has been awarded the William Julius Mickle Fellowship for 1930 in respect of research work (radiographic and histological) during the past five years in connexion with problems of growth in man and animals

Dr Francis Davies has been appointed, as from Aug 1, to the University readership in anatomy tenable at King's College Dr Davies was educated at University College, Cardiff, and continued his medical studies at University College Hospital, London From 1924 until 1927 he was demonstrator, and since 1927 he has been senior demonstrator in anatomy at University College

Prof L T Hogben has been appointed as from Aug 1 to the University chair of social biology tenable at the London School of Economics In 1912, Prof Hogben entered Trinity College, Cambridge, with a major entrance scholarship, and in 1915 he obtained the Frank Smart Prize in zoology From 1919 until 1920 he was lecturer in zoology at Birkbeck College, and from 1920 until 1922 lecturer in the Department of Zoology and Huxleyan Curator at the Imperial College of Science In 1922 he was Mackinnon Student of the Royal Society He was at the University of Edinburgh from 1923 until 1925 as lecturer in experimental physiology, and at McGill University from 1925 until 1927 as assistant professor of zoology Since 1927 he has been professor of zoology in the University of Cape Town

Some attractive cinematograph displays of Empire films are being given at the Imperial Institute During the present month, films dealing with various aspects of life in Africa, the West Indies, the Antarctic, Australia, and India, and a natural history film are being shown for successive periods There are four sessions daily, except on Sundays, when there are two sessions Admission is free but seats are reserved on application in writing to the secretary of the Institute

The Foreign Work Committee of Leplay House is arranging to send a group of members and others to North Africa during the coming Easter vacation, under the leadership of Mr E M Keith Ellerton, of the University of Liverpool The route covered is Algiers to Biskra and Touggourt, then to Tunis via Timgad and Constantine Another group will go to Brittany, making Carnac its centre, for archæological studies, and another to Holland Those interested in field studies from the point of view of architecture, history, geography, and sociology should apply to Miss Margaret Tatton, Director, Foreign Work Committee, Leplay House, 65 Belgrave Road, S W 1

Historic Natural Events

Mar 11, 1669 Eruption of Etna —One of the greatest eruptions of Etna, preceded by violent earthquakes for three days, began by the opening of a fissure nearly 12 miles long on the south side of the mountain A new crater opened 8 miles west of Acireale, the ashes from which formed the double cone now known as the Monti Rossi The lava stream from the crater covered an area of about 40 sq miles It destroyed 14 villages, including Belpasso and Mascalucia, invaded Catania, mounting over the wall 60 ft high, and finally reached the sea in a stream 600 yards wide and 40 feet deep

Mar 11, 1912 Darkness and Black Rain —In the afternoon of Mar 11 a severe thunderstorm took place in the east of Hampshire and the west of Sussex A peculiar feature was the intense darkness that occurred near the centre of the storm The sky was described as of inky blackness, in other places the cloud was greenish yellow and dense fog was experienced The rain which fell from this cloud was black like ink, and smelt slightly of tar There seems little doubt that the blackness was actually due to London fog which drifted southwards before a light wind until it reached the thunderstorm area

Mar 11-14, 1888 'The Great March Blizzard' —This was the worst storm in the history of the eastern United States An elliptical trough of low pressure moved eastward, with two intense centres, the northern centre passed out over the Atlantic on Mar 11, while the southern centre turned north eastward and remained in the neighbourhood of Cape Cod from Mar 12 to 14, gradually becoming less intense On the western side of these two depressions intensely cold northerly winds blew with great force, the temperature being little above 0° F in the interior of Connecticut and New York, and the wind up to 70 miles per hour West of 72° W the snowfall was excessive, and piled up in immense drifts The average depth of undrifted snow exceeded four feet in parts of New York State, and caused almost complete cessation for several days of railway traffic entering New York City

Mar 13, 1252 Drought and Disease —This great drought was associated with persistent north, north-east, or east winds "On the 13th day of March there began a sore drought, continuing a long time The grass was so burned up in pastures and meadows that if a man took some of it in his hands it straight fell to powder, and so cattle were starved for lack of meat And because of the exceeding hot nights there was such abundance of fleas, flies, and gnats that people were vexed and brought in case to be weary of their lives And herewith chanced many diseases, as sweats, agues, and other In the harvest time fell there a great death and murrain amongst cattle, and especially in Norfolk, in the Fens, and other parts of the south This infection was such that dogs and ravens feeding on the dead carrion, swelled straightway and died, so that the people durst eat no beef lest the flesh haply might be infected "

Mar 13, 1523 Storm and Flood —A severe thunderstorm accompanied by violent winds broke over Holland, hailstones the size of hen's eggs fell A dam burst at Schalkwyk, causing great floods on the Leck from Schalkwyk to Leyden There were many thunderstorms throughout the following summer

Mar 13, 1924 Sun Pillar —A fine sun pillar was widely observed over southern and eastern England, including London, and also in Ireland At Turnham Green it was first seen at 5 45 P M, when it formed

a whitish vertical streak equal in width to the sun and reaching up to 5° above it The sun's disc was strangely distorted before it disappeared at 5 49, and the pillar remained visible until 6 9 At Golders Green at 5 30 it came out of the sun's disc like a tree trunk, red orange in colour, turning to gold and then becoming whiter Other observers described it as blood-red, apricot, or rose pink streaked with primrose yellow, but all agreed on its extreme beauty Some experienced observers estimated the height as 30°, though sun pillars exceeding 15° are exceedingly rare

Mar 15, 1889 Hurricane at Samoa —On Mar 15 the harbour of Apia, Samoa, was crowded by seven warships, one British, three American and three German, all of which had been sent there because of the strained political situation, as well as two merchant ships and two schooners On the afternoon of that day the island was struck by a violent hurricane from north north east (the harbour opens to the north), and all the vessels were either sunk or driven ashore with the exception of H M S *Calliope*, which was able to steam out of the harbour

Mar 15, 1929 Floods in Alabama —As a result of heavy rain at the end of February and early in March, the valleys of the Choctawhatchee and Escambra Rivers in Alabama were already saturated with water, when on Mar 13–15 further heavy rains fell over the district, reaching 29 6 inches in three days at Elba, of which 20 inches fell on Mar 15 (This amount is partly estimated, as the rain gauge was carried away by the floods after 14 inches had been recorded) The towns of Elba and Brewton, at the junctions of rivers, were flooded to a depth of more than 10 feet in places, and great damage was done, estimated at nearly five million dollars Owing to the flood warnings, no lives were lost

Societies and Academies

CAMBRIDGE

Philosophical Society, Jan 27 —**A F H Ward** A microcalorimeter A microcalorimeter was described accurate to 0 0005 cal The system liberating the heat fits closely inside a copper tube contained in a Dewar flask A series of iron constantan thermo couples has one set of junctions making good thermal contact with the tube and the others in a brass ring outside, kept in a thermostat They are connected to a sensitive moving coil galvanometer The Tian multiple walled thermostat is used—three concentric thick copper cylinders, insulated with kapok, the inner containing water The temperature of the outer cylinder is controlled with a mercury regulator, and the insulating layers cut down temperature variations so that the inner vessel is constant to less than 1/500,000 C°

PARIS

Academy of Sciences, Jan 27 —The president announced the death of General Sebert —**L Cayeux** The existence of two groups of Algæ with the structure preserved in the 'schisto limestone system' of the French Congo There is ground for supposing that, in the oolitic complex of the limestone schists of the French Congo, certain limestones of oolitic appearance are petrified Algæ —**Charles Nicolle, Paul Durand, and Ernest Conseil** Preventive vaccination against plague pneumonia by the respiratory tract In addition to the usual injection of dead plague bacilli, a method of inhaling a suspension of the serum as a spray was tried 866 cases were treated, and less than 1 per cent died of the plague —**Serge Bernstein** A class of polynomials of minimum deviation —**Louis Roy** The fundamental equation of shock waves on elastic surfaces —**G Friedel and R Weil** The influence of the symmetry of the medium on the symmetry of the crystalline forms —**Auguste Lumière and Mlle Anna Malespine** The impeding influence of gestation on the Arthus phenomenon —**Alexandre Ostrowski** Some generalisations of the Euler product $\prod_{\nu=0}^{\infty}(1 + x^{2\nu})$ —**S Stoilov** The topological character of a theorem on the meromorph functions —**W Břečka and J Geronimus** An inequality for monotone polynomials —**Henri Eyraud** The summation of divergent integrals in the theory of spectra —**M A Andronow and A Witt** The mathematical theory of auto oscillations —**F Campus** The mean fibre of large hyperstatic arches —**Maurice Lambrey** The influence of foreign gases on the absorption spectrum of nitric oxide —**Félix Ehrenhaft** Magnetophotophoresis and electro-photophoresis A description of the phenomena observed when submicroscopic particles are examined under the microscope in a powerful magnetic field and in an electric field —**J J Trillat** The structure of gelatine The results of an X ray study of films of gelatine —**Jean Dalsace, M Gory, and Nemours-Auguste** An attempt on the radiographic visibility of the kidney Intra arterial injection of lipiodol, which is not toxic to the animal, brings out anatomical details in radiographs, especially in the kidney and suprarenal capsules —**J Décombe** The passage from the β ketonic esters to the β-amino esters The reduction of the azines or oximes of the β ketonic esters by the usual reducing agents does not give the amino esters, as might have been expected the reduction of the acetylhydrazones or benzoylhydrazones of these esters, however, gives the amino esters with fair yields —**L Haskelberg** Researches on the preparation of the glycerol esters of the amino acids —**Augustin Boutaric and Mlle Madeleine Roy** Researches on the sedimentation of suspensions of clay The results described are in general agreement with those obtained by Dubrisay —**H Besaire and Mlle E Basse** New stratigraphical and palæontological observations on the upper Cretaceous of the province of Maintirano (west of Madagascar) —**Ch Brioux and Edg Jouis** The correlation between the fineness and the solubility in carbonic acid of powdered limestones, and their neutralising action on acid soils The availability for agricultural purposes of powdered limestone is shown to depend on its state of division The neutralising action in the soil is in direct relation with the rate of solution in solutions of carbon dioxide A commercial method of valuation based on these facts is suggested —**P Chevey** Various rhythms other than thermal rhythms capable of marking the scales of fishes of the intertropical zone —**E Kohn-Abrest, Mlle Hélène Villard, and L Capus** The presence of thiocyanates in the human organism The post mortem transformation of veronal, dial, gardenal into cyanogen compounds Consequences in toxicology It is known that hydrocyanic acid under the influence of putrefaction can be partially converted into thiocyanic acid, and the presence of the latter is frequently the only proof of poisoning by a cyanogen compound Human viscera, even after much putrefaction, are normally free from thiocyanates, but after the administration of veronal, dial, or gardenal, appreciable quantities of thiocyanates can be found These new facts must be taken into account by toxicologists

COPENHAGEN

Royal Danish Academy of Science and Letters, Nov 15 —**Elis Strömgren** Continued researches on the restricted problem of three bodies Continued

researches on asymptotic solutions in the restricted problem of three bodies have led to the discovery of a whole system of hitherto unknown classes of periodic orbits

Nov 29—**Harald Bohr** (1) On integral functions General solution of a problem proposed by Borel—(2) On analytic, almost periodic, functions—**C Wesenberg-Lund** Contributions to the biology of the Rotifera (2) Deals mainly with the sexual biology of the Rotifera, studied for several years in a series of ponds in the northern part of Seeland—**Ojvind Winge** Sex-determination in the Cyprinodont *Lebistes reticulatus* In *Lebistes*, individuals with two X-chromosomes are generally females and XY-individuals are males As an exception XX males are produced, owing to genes, outside the Y chromosome, pulling in male direction This observation explains to a certain degree the peculiar disagreement between the sex-determination in *Lebistes* and the closely allied genus *Platypœcilus*, where the males have XX and the females XY chromosomes

ROME

Royal National Academy of the Lincei, Nov 3—**C Foà** and **A Peroni** First attempts to register action currents of the acoustic nerve—**P Tortorici** The principle of the arithmetic mean—**A M Bedarida** The theory of ideals of a finite algebraic body (4)—**I Todros** Projective differential investigations on pairs of plane lines or of surfaces—**E Gugino** The validity and extension of the theory of maximum effort—**G Supino** Certain integral properties of cubic expansion For certain investigations to be published shortly, use has been made of the following integral relations concerning the cubic expansion Θ of an elastic solid S subjected to external forces in equilibrium acting only on its surface σ

$$(1) \qquad \int_S \Theta dS = \frac{mE}{m-2}\int_\sigma (xP_x + yP_y + zP_z)d\sigma, \text{ and}$$

$$(2) \qquad \int_S y\Theta dS = \frac{mE}{m-2}\int_\sigma \left(xyP_x + \frac{y^2 - x^2 - z^2}{2}P_y + yzP_z\right)d\sigma$$

With these as starting point, it is shown that, if a system of forces in equilibrium (with components P_x, P_y, P_z) acts on a single plane zone σ, of an elastic solid, the total cubic expansion caused in the solid by these forces is zero—**E Raimondi** The dynamic effect of a translatory circulatory current investing a thin cylinder in the neighbourhood of an indefinite plane wall—**G Wataghin** An application of relativity to quantum mechanics The principal differential equations used in quantum mechanics and in the theory of relativity may be derived from a single variational principle—**M Merola** The variability of Y Canes Venatici—**P Tortorici** New determination of the local deviation in latitude and in longitude at the Astronomical Observatory of Palermo—**F Scandone** The Hall effect with extended electrodes (3)—**L Mascarelli** and **D Gatti** Contribution to the knowledge of diphenyl and of its derivatives (5) To obtain derivatives of diphenyl, use has been made of various methods which serve to prepare the corresponding derivatives of benzene—**O Cantoni** Investigations on the supposed existence of pulmonary lipo-dieresis Experimental results, obtained under various conditions, fail to confirm the hypothesis of pulmonary lipo dieresis

VIENNA

Academy of Sciences, Nov 28—**M Beier** Zoological expedition to the Ionian Islands and the Peloponnesus (6) Fishes worked out by M Holly—**E. Schweidler** The disintegration constant of radium D—**H Hornich** The complete independence of Menger's axioms of dimension—**F Morton** Measurements of brightness with grey-wedge photometers on a sea voyage from Europe to Guatemala and in Guatemala, 1928–29 The exposed strips of photometer paper wrapped in tinfoil were sent back every four weeks to the observatory at Davos Platz for development The values found for insolation were less than those at Davos

Dec 5—**A Köhler** Geological and petrographical investigations into the deeper rocks of the Lower Austrian Waldviertel and its boundary regions (1)—**A Köhler** Chemical analysis of the hornstone rock of Niederndorf near Erlauf, Lower Austria—**M Beier** Zoological expedition to the Ionian Islands and the Peloponnesus (7) Ixides worked out by P Schulze—**A Zinke** and **R Wengen** Perylene and its derivatives (28)—**K Ehrenberg** A remarkable bear's skull from the Bärenhöhle near Winden in Burgenland—**G T Whyburn** The sum of regular curves

Dec 12—**F Becke** The systematics and nomenclature of the 32 symmetry classes of crystals The German mineralogical society discussed this matter in Duisburg in 1926 and in Breslau in 1927 F Becke, E Schiebold, and F Rinne expressed themselves in lectures at Breslau, and F Rinne has put his proposals in final form in 1929 in Vol 50 of the *Abhandlungen* of the Saxon Academy—**W Schmidt** and **P Lehmann** Experiments on the 'breathing' of soil Under oscillations of atmospheric pressure the air in the soil is movable—**A Dadieu** and **K W F Kohlrausch** The Raman spectrum of organic substances Various substances were tried, esters and salts of acetic acid, derivatives of benzol The acetone line λ3008 was not verified—**K Przibram** Remarks on natural blue rock salt There may be layers in the crystals corresponding to cubic and other layers corresponding to rhombic dodecahedral surfaces Secondary recrystallisation is a possibility—**G Schaum** Communication of the Radium Institute No 245a Action of β and γ rays on electrolytic solutions A capillary tube with 30 mgm radium was submerged in a concentrated solution of silver nitrate for two months A grey precipitate formed

Jan 16—**L Moser**, **K Neumayer**, and **K Winter** Determination and separation of rare metals from other metals (19) New methods for the separation of titanium from other elements Tetravalent titanium can be precipitated in sulphuric acid solution by means of tannic acid and antipyrine—**A Kailan** and **A Ostermann** Velocity of esterification with ethyl-alcoholic, ethylene glycolic, and glyceric hydrochloric acid—**H R v Gaertner** Geology of the Central Carnic Alps A great number of new fossil finds in Silurian, Devonian, and Carboniferous strata, including graptoliths and trilobites in upper Silurian and cephalopods in upper Devonian—**J Schaffer** Change of function in gland organs of the skin The shrew mouse has skin glands commonly called sweat glands but secreting fat and albumen with a characteristic smell more probably these are scent or trail glands The water shrew has glands that swell in the breeding season, so also the sebaceous glands of the gemse The secretion in the gland bag of the badger seems to change from youth to age—**M Glaessner** The danic stage in the Gosau basin Conglomerates in the Salzkammergut—**R Ebner** and colleagues Hymenoptera from Palestine and Syria (Zoological expedition, 1928)—**P Esben-Petersen** Neuroptera (F Werner's zoological expedition to the Anglo Egyptian Sudan, 1914)—**F Werner** Scientific results of a zoological expedition to western Algeria and Morocco (3)—**J Hoffmann** Communication of the Radium Institute (246) Behaviour of ultramarine and of some natural and artificial silicates towards radium rays—**K Menger** Sketch of a new theory of measure Axioms of dimension and measure

Official Publications Received

BRITISH.

Paleontologiese Navorsing van die Nasionale Museum, Bloemfontein Deel 1, Eerste Stuk Die Krytfauna van Soelosland 1 Trigoniidae Deur Dr Ir E C N Van Hoepen Pp 38+7 plates (Bloemfontein)

Ministry of Agriculture and Fisheries Miscellaneous Publications No 70 Report on the Occurrence of Fungus, Bacterial and Allied Diseases of Crops in England and Wales for the Years 1925 1926 and 1927 Pp 75+2 plates (London H M Stationery Office) 3s 6d net

The University of Manchester The Manchester Museum Museum Publication 97 Report for the Year 1928-29 Pp 26+2 plates (Manchester) 6d net

Air Ministry Aeronautical Research Committee Reports and Memoranda. No. 1250 Reports and Memoranda of the Aeronautical Research Committee published between 1st August 1928 and 31st August 1929 Pp 7 6d net No 1227 (M 62) High Frequency Fatigue By G F Jenkin and G D Lehmann (E F 219) Pp 34 1s 6d net (London H M Stationery Office)

Leeds University Report to the Worshipful Company of Clothworkers of the City of London of the Advisory Committee on the Departments of Textile Industries and Colour Chemistry and Dyeing, during the Session 1928 29 Pp 14 (Leeds)

University of Leeds Clothworkers Departments Report of the Work done under the Research Scheme established in 1928 with the aid of a Special Grant from the Worshipful Company of Clothworkers, Session 1928–29 Pp 16 (Leeds)

The Dioptric Review the Transactions of the British Optical Association Edited by John H Sutcliffe Vol 32, No 2 February Pp 36 83 (London)

Report on the Second Imperial Mycological Conference, 1929 Pp 42 (London H M Stationery Office) 1s 6d net

University College of Wales, Aberystwyth Welsh Plant Breeding Station Experiments to test the Yield and other Properties of various Species and Strains of Herbage Plants under Different Methods of Management By R G Stapledon and William Davies (Series H, No 10, Seasons 1928-28) Pp 42 (Aberystwyth) 3s 6d

Air Ministry Aeronautical Research Committee Reports and Memoranda. No 1251 Some Early Model Experiments on Devices for Improving Lateral Control near the Stall By H B Irving and A S Batson Pp 5+7 plates (London H M Stationery Office) 1s net

The National Institute of Agricultural Botany Tenth Report and Accounts 1928 29 Pp 22 (Cambridge)

The Journal of the Royal Horticultural Society Edited by F J Chittenden Vol 55, Part 1 January Pp 107+lxxv+43 plates (London) 7s 6d

FOREIGN

Publications of the Kapteyn Astronomical Laboratory at Groningen No 43 Distribution of Stars according to Apparent Magnitude Galactic Latitude and Galactic Longitude By Prof Dr P J Van Rhijn Pp ii+104 No 44 Photovisual Magnitudes for the Selected Areas at $\delta=+75$, derived from Plates taken at the Leander McCormick Observatory by H L Alden and P van de Kamp Discussed by Prof Dr P J Van Rhijn and B J Bok Pp ii+19 (Groningen Hoitsema Bros)

Ministero dell Aeronautica, Aviazione civile e Traffico aereo Annali dell Ufficio presagi Vol 2 Pp 202+4 tavole (Roma.)

Collection des travaux chimiques de Tchécoslovaquie Rédigée et publiée par E Votoček et J Heyrovský Année 2, No 1 Janvier Pp 61 (Prague Regia Societas Scientiarum Bohemica)

Statens Skogsförsöksanstalt Meddelanden Häfte 25 Pp iii+317 7 00 kr Exkursionsledare, 13a Führer der Exkursionen des Internationalen Kongresses Forstlicher Versuchsanstalten Stockholm, 1929 Pp 97+59 Flygblad No 30 Skogsträdens Fruktsättning år 1928 Av I Tirén Pp 19 (Stockholm Centraltryckeriet)

Agricultural Experiment Station of the Rhode Island State College Bulletin 222 The Production of Gas by *Salmonella pullorum* II By John C Weldin and Helen I Weaver Pp 25 (Kingston R I)

U S Department of Agriculture Farmers Bulletin No 1612 Propagation of Aquatic Game Birds By W L McAtee Pp ii+41 10 cents Farmers Bulletin No 1613 Propagation of Upland Game Birds By W L McAtee Pp ii+61 10 cents. (Washington, D C Government Printing Office)

The Science Reports of the Tôhoku Imperial University Sendai, Japan First Series (Mathematics, Physics Chemistry) Vol 18 No 4 Pp 419 579 (Tokyo and Sendai Maruzen Co, Ltd)

CATALOGUES

Catalogue of Second hand Books, including the Libraries of the late H V Macnaghten and R D Hicks with Books from other Libraries recently Purchased (No 341) Pp 90 (Cambridge W Heffer and Sons Ltd)

Scarce and Interesting Old Books First Editions, Americana, Old Novels, Early Law Books (No 28) Pp 90 (Newcastle on Tyne William H Robinson)

Catalogue de livres anciens et modernes, rares ou curieux relatifs à l Orient (No 12) Pp 277 362 (Paris Libr Adrien Maisonneuve)

Diary of Societies

FRIDAY, MARCH 7

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10 30 A M—G J Jenkins, Dr J S Fraser, and E B Barnes Discussion on Malignant Disease of the Ear

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 3 45—T B Layton Demonstration of The Rhinological Anatomy of the Naso-frontal Duct and the Hiatus Semilunaris.

ANDERSONIAN CHEMICAL SOCIETY (at Royal Technical College, Glasgow), at 8.15—Dr Cumming Lignin

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4 30

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 4 30—The History of Mountains Opener Dr Harold Jeffreys

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5

INSTITUTION OF MECHANICAL ENGINEERS, at 6—J W Schuster The Strength and Design of Fusion Welds for Unfired Pressure Vessels

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (at Engineers Club, Manchester) at 7—Dr F L Pyman Fine Chemicals

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7—A E Moore and W T Slater An Investigation of the Frequency Variations in Induction Watt-hour Meters

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Annual General Meeting), at 7

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Informal Meeting) (at Bolbec Hall Newcastle upon Tyne) at 7 15—W D Horsley and others Discussion on The Effect of the Use of Electricity in Workshops on Efficiency and Costs

JUNIOR INSTITUTION OF ENGINEERS at 7 30—Lt Col G J Hartley Chile and Engineering in Chile

INSTITUTE OF METALS (London Local Section) (at 83 Pall Mall), at 7 30—A Coad Pryor The Manufacture of Glass and some of its more Interesting Properties

GEOLOGISTS ASSOCIATION (at University College), at 7 30—Dr A E Trueman The Lower Lias (Bucklandi Zone) of Nash Point Glamorgan—A A Fitch The Geology of Etchingham and Robertsbridge Sussex—G S Sweeting The Geological Structure of the Ashburnham Battle and Crowhurst Districts Sussex with Notes on the Wealden Iron Ore

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8 30—Dr C Donald Spinal Analgesia with Spinocain—Dr H Jones Percain Ciba a New Regional and Spinal Analgesic with Special Reference to High Thoracic Nerve root (Splanchnic) Block

ROYAL INSTITUTION OF GREAT BRITAIN at 9—Dr C Tate Regan Angler Fishes

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (jointly with Glasgow Section) (at Institution of Engineers and Shipbuilders Glasgow)—J S F Gard and R F Robinson The Insulation of Heated and Cooled Surfaces

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB—Prof C E Inglis The Construction of a Great Suspension Bridge

SATURDAY, MARCH 8

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Annual District Meeting) (at Lecture Hall Taunton) at 11 A M

ROYAL INSTITUTION OF GREAT BRITAIN at 3—Sir Ernest Rutherford Atomic Nuclei and their Structure (I)

BRITISH PSYCHOLOGICAL SOCIETY (General Meeting) (at Bedford College) at 3 30—Dr V Hazlitt Children s Thought—Miss A M Jenkin Imagery and Learning

BRITISH ASSOCIATION OF MANAGERS OF TEXTILE WORKS (at Manchester Athenæum), at 6 30—F Nasmith The Increasing Use of Cotton Fabrics for Industrial Purposes

MONDAY, MARCH 10

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5—C E Shattock Demonstration of Affections of Joints

KING S COLLEGE ENGINEERING SOCIETY at 5 15—A H S Oddy Pulverised Fuel

ROYAL AERONAUTICAL SOCIETY (jointly with Institute of Transport) (at Royal Society of Arts) at 6 30—Herr Wronsky Air Transport

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Queen s Hotel, Birmingham) at 7—W H Goddard The Mercedes Benz Diesel Engine

INSTITUTION OF ELECTRICAL ENGINEERS (North Eastern Centre) (at Armstrong College, Newcastle upon Tyne) at 7

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members and Graduates Section) (at Borough Polytechnic), at 7—L J Fowler Some District Heating Systems

INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow) at 7 30—Annual General Meeting

MEDICAL SOCIETY OF LONDON, at 8—Dr J W McNee and others Discussion on Cardiac Infarction

SURVEYORS INSTITUTION at 8—Sir Harry Haward Recent Developments in Electricity Supply in Great Britain, with Special Reference to Rural Electrification

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8 30—F Kingdon Ward The Eastern Gate to India

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Bristol)

TUESDAY, MARCH 11

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15—Dr C Singer The Passage from Medieval to Modern Science (I) Science in the Middle Ages

INSTITUTION OF CIVIL ENGINEERS, at 6—H D Smith Reconstruction of Liskeard Viaduct, and Scheme for Reconstruction of the Approach Spans of the Royal Albert Bridge Saltash—F Gibbons Reconstruction of Approach Spans Royal Albert Bridge Saltash—J Alexander Reconstruction of Kent and Leven Viaducts, Furness Section of the London Midland and Scottish Railway

INSTITUTE OF MARINE ENGINEERS at 6 30—A T Wall The Advantages to the Shipowner of Closer Co operation between the Naval Architect and the Marine Engineer

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at North British Station Hotel, Edinburgh) at 7—Capt P P Eckersley Broadcasting by Electric Waves (Faraday Lecture).

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7—Annual General Meeting

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch—Burnley Section) (at Municipal College, Burnley), at 7 15—A. Sutcliffe Jobbing Castings

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at King's Head Hotel, Coventry), at 7 30—Capt. J S Irving Problems Encountered in the Design of the *Golden Arrow*

Manchester College of Technology Textile Society (at Manchester), at 7 30.—J Innes Artificial Silk Manufacture
Quekett Microscopical Club (at 11 Chandos Street, W 1), at 7 30 —Prof R. R. Gates Vegetation and Man in the Canadian Arctic
Eugenics Society (at Linnean Society), at 8.—W A. Appleton and others Discussion on Unemployment.
Leicester Literary and Philosophical Society (Chemical Section) (at Museum, Leicester), at 8 —Discussion on The Profession of Chemistry
Royal Society of Medicine (Psychiatry Section) (jointly with British Psychological Society), at 8.30 —Discussion on The Rôle of Psychotherapy in the Treatment of Psychoses
Pharmaceutical Society, at 8 30 —Prof R V Wheeler The Chemistry of Coal

WEDNESDAY, March 12

Geological Society of London at 5 30 —R. W Pocock The Age of the Midland Basalts —Dr T Robertson The Origin of the Etruria Marl
Institution of Civil Engineers (Informal Meeting), at 6 —F M G Du Plat-Taylor Land Reclamation Work
Society of Chemical Industry (Newcastle Section) (Annual Meeting) (at Armstrong College, Newcastle upon Tyne) at 7 30 —J A. Reavell Some New Aspects of Evaporation
Royal Society of Arts, at 8 —Prof G Elliot Smith The Human Brain
Oxford University Junior Scientific Club.—Dr G Wachsmuth Cosmic Formative Forces in Earth and Man

THURSDAY, March 13

Royal Society, at 4 30 —V B Wigglesworth A Theory of Tracheal Respiration in Insects —H Raistrick and others Studies in the Biochemistry of the Lower Fungi
London Mathematical Society (at Royal Astronomical Society), at 5 —W N Bailey Some Classes of Functions which are their own Reciprocals in the Fourier Bessel Integral Transform —E T Davies The Equations of Gauss and Codazzi for Spaces with Torsion —D E Littlewood (a) Algebras in which the Equation $yx - xy = 1$ has a Solution, (b) Identical Relations Satisfied in an Algebra.—Prof L J Mordell (a) The Zeta Functions Arising from Quadratic Forms of which the Real Parts are Definite or Indefinite Forms, and their Functional Equations (b) Note on Kapteyn s and Bateman s Integrals Involving Bessel Functions —V Naylor Euler s Method of Summation
Royal Institution of Great Britain, at 5 15 —J B S Haldane Some Problems of Genetics
Society of Chemical Industry (Liverpool Section jointly with Institute of Chemistry—Liverpool and North West Section), (at Liverpool University), at 6 —W Doran Odour and Chemical Constitution.
Child-Study Society (at Royal Sanitary Institute), at 6 —R. A. Raven The New Prospect for our Adolescents Some Reflections
Institution of Electrical Engineers, at 6 —H A. Humphrey D M Buist, and J W Bansall The Imperial Chemical Industries Limited s Steam and Electric Power Plant at Billingham
Institute of Marine Engineers (Junior Section) at 6 30 —Engr Lieut. Comr H S Humphreys Marine Boilers Their Troubles and Maintenance
Royal Photographic Society of Great Britain (Colour Group—Annual General Meeting), at 7
Institution of Electrical Engineers (Dundee Sub-Centre) (at University College, Dundee) at 7 30
Optical Society (at Imperial College of Science and Technology), at 7 30.—T Smith Imagery Around a Skew Ray Part I Conjugate Points Part II Fourth Order Matrices for Skew Pencils Part III Sixth Order Matrices for Skew Pencils —Prof R A Sampson The Purpose and Design of the New Equipment at the Royal Observatory, Edinburgh —Adam Hilger, Ltd A Description of the Stellar Spectrograph for the 36" Reflector at the Royal Observatory, Edinburgh —Sir Howard Grubb, Parsons and Co A Description of the 36" Reflector at the Royal Observatory, Edinburgh
Institution of Automobile Engineers (Plymouth Centre) (at Devonport Technical College) at 8 —Capt L W Johnson The Inspection of Metals and their Alloys.
Royal Society of Medicine (Neurology Section), at 8 30 —Discussion on Injuries to the Brachial Plexus
North East Coast Institution of Engineers and Shipbuilders (Tees-side Branch).—A. Herbert, Ltd Films of The Age of Speed, and The 30th part of a Hair

FRIDAY, March 14

Biochemical Society (Annual General Meeting) (in Department of Physiology and Biochemistry, University College), at 3 —R A McCance and K. Madders The Comparative Rates of Absorption of Certain Sugars from the Human Intestine.—A. Hunter and J A. Dauphinee The Rate of Liberation of Arginine in the Tryptic Digestion of Proteins —Prof. A Harden and M. G Macfarlane Fermentation by Yeast Preparations.—G F Marrian and P F Marrian Microdeterminations of Hydroxyl Groups by Grignard s Reagent —G F Marrian (a) Further Observations on the Alcohol Isolated from the Urine of Pregnancy (b) An Improved Method for the Preparation of Œstrin The Isolation of Active Crystalline Material from Urine —B. Ahmad and Dr J C Drummond Observations on the Relation of Carotene to Vitamin A.—L F Hewitt Oxidation reduction Potentials of Cultures of Hæmolytic Streptococci —C A. Ashford The Phosphorus Distribution in Blood during Hypervitaminosis —R. A. Morton, I M Heilbron, and A. Thompson Some Further Observations on Vitamin A —R. A. Morton and I M Heilbron A Note on the Vitamin A of Butter —T Moore The Conversion of Carotene to Vitamin A *in vivo*. —F Dickens The Preparation and Properties of an Active Principle from the Urine of Pregnancy —K H Coward, K M Key, R. Morgan, and F J Dyer Variation in Vitamin A Assay
Royal Society of Medicine (Ophthalmology Section) (at Guy s Hospital), at 5 —Clinical Meeting.
Royal College of Surgeons of England, at 5 —Sir Frank Colyer Demonstration of John Hunter s Specimens of the Teeth
Physical Society (at Imperial College of Science and Technology), at 5
Malacological Society of London (at Linnean Society), at 6
Royal Meteorological Society (jointly with Royal Aeronautical Society) (at Institution of Electrical Engineers), at 6.30 —Dr F Nansen The Aims and Objects of the Aeroarctic.
Society of Chemical Industry (Glasgow Section) (Annual Business Meeting), at 6 45
Institution of Mechanical Engineers (Informal Meeting), at 7 —Exhibition of Industrial Kinematograph Films
Junior Institution of Engineers, at 7 30 —W A. Saille An outline of Siemen s No. 50 Telephone Switching equipment
Institute of Metals (Sheffield Local Section) (at Sheffield University), at 7 30.—A G Lobley Electric Heat Treatment Furnaces
Royal Institution of Great Britain, at 9 —Prof G Elliot Smith New Light on Vision.
Institute of Rubber Technologists (at Manchester Café, Ltd., Manchester).—G F Thomson Colours used in the Rubber Industry

SATURDAY, March 15.

Royal Institution of Great Britain, at 3 —Sir Ernest Rutherford Atomic Nuclei and their Structure (2).
Physiological Society (at University College).—Annual General Meeting
Royal Irish Academy (Dublin).

PUBLIC LECTURES

SATURDAY, March 8

Horniman Museum (Forest Hill), at 3 30 —Prof J R Ainsworth Davis Casting Life in New Moulds

MONDAY, March 10

Birkbeck College, at 5 30 —Prof V M Goldschmidt Chemical Geology (Succeeding Lecture on Mar 11)
University College, at 5 30 —Prof E J Salisbury Concerning The Study of Plants

TUESDAY, March 11

University College at 5 —Prof J C Brash The Growth and Developmental Mechanics of Bone (Succeeding Lecture on Mar 18)
King s College, at 5 30—Prof J H Muirhead Prospect and Retrospect in British Philosophy

WEDNESDAY, March 12

Royal Anthropological Institute (at Portland Hall Great Portland Street Extension of Regent Street Polytechnic), at 5 30 —Prof J L Myres The Early Use of Metals.
University College, at 5 30 —Prof J Steffensen Some Recent Researches in the Theory of Statistics and Actuarial Science (Succeeding Lectures on Mar 13 and 14)
British Medical Association (Tavistock Square), at 8 —Sir Andrew Balfour Health and Empire (Sir Charles Hastings Lecture).

THURSDAY, March 13

Sir John Cass Technical Institute (Jewry Street E C 3), at 8 —Prof T P Hilditch The Structure of Fats and its Bearing on their Utilisation

SATURDAY, March 15

Horniman Museum (Forest Hill), at 3 30 —H N Milligan Monsters of the Deep.

CONGRESS

March 12 and 13

Institute of Metals (at Institution of Mechanical Engineers).
Wednesday, March 12, from 10 a m to 12 30 p m.—Presidential Address
Dr D Stockdale The Composition of Eutectics
Dr T A. Rickard The Early Use of the Metals
From 2 to 4.—N P Allen Experiments on the Influence of Gases on the Soundness of Copper Ingots.
W E Prytherch Gases in Copper and their Removal
E J Daniels Unsoundness in Bronze Castings
R Genders Macrostructure of Cast Alloys. Effect of Turbulence Due to Gases
Thursday, March 13, from 10 a.m. to 1 p m —Dr D Hanson, S. L Archbutt, and Grace W Ford Investigation of the Effects of Impurities in Copper Part VI The Effect of Phosphorus in Copper
R. Genders The Aluminium Brasses
Dr C. F Elam The Diffusion of Zinc in Copper Crystals.
From 2 to 4 —L. Davies and L Wright Protective Value of Some Electro-Deposited Coatings
R. Lancaster and J G Berry A Note on Zinc-Base Die-Casting Alloys.
Prof B. P Haigh and B Jones Atmospheric Action in Relation to Fatigue in Lead
W R D Jones A Note on Metallic Magnesium

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SATURDAY, MARCH 15, 1930

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No 3150, Vol 125]

Vaccination

VACCINATED persons, when exposed to the same risk of taking smallpox as unvaccinated persons, are attacked at a lower rate, and those who are attacked die at a lower rate than persons who have not been vaccinated No one who is acquainted with the direct and collateral evidence doubts that this is a generally true proposition, unless they are on *a priori* grounds convinced that vaccination must be nonsense As Prof Major Greenwood pointed out to the Royal Statistical Society on Feb 18, direct numerical evidence of the lower attack and lower fatality rates of vaccinated persons has been obtained whenever the distinction between vaccinated and unvaccinated has been recorded Recent advances in understanding have all confirmed our belief in the efficacy of vaccination as an individual prophylactic

Jenner thought that cow pox (vaccinia) and smallpox (variola) were distinct diseases, and such has been the uncritical general opinion almost to the present day It was accepted on all hands that an attack of smallpox, either naturally contracted or imposed by deliberate inoculation, was a fairly efficient protection against a second attack But it naturally seemed a little strange that protection could be obtained by an attack of another disease, and there were no clear analogies of this non-specific immunisation measles protected against measles, chicken pox against chicken pox, distemper against distemper , and it is not altogether surprising that acute men like Charles Creighton came to the conclusion that vaccination was quackery

Was Jenner right, however, in his original interpretation of his facts ? The modern view is that he was not, and that what he called cow pox on the cows' udders and dairymaids' hands was in fact smallpox No one now knows exactly what cow pox was or is the disease, if it ever had an independent existence, is almost or quite unknown nowadays Equally, the original sources of the strains of virus used for making vaccine lymph for human use are not always known, or at any rate the information is not available for the interested public In some instances, however, they are admittedly derived from human variola, and it seems most likely that all or nearly all human vaccination is actually performed with smallpox material cultivated in the skins of calves, sheep, rabbits, monkeys, or some combination of these and other animals In short, vaccination to-day is essentially the same as the inoculation of the eighteenth century we still protect against small-

pox by inoculating with smallpox, only we use a milder strain of virus, which has to a large extent lost its particular capacity to cause serious illness and death in man by being adapted to grow in other species of animals There is, therefore, nothing surprising or repugnant to general principles in the fact that 'vaccinia' protects against variola Their identity has been fully confirmed by the intensive studies and animal experiments made in recent years by Gordon, Tulloch, and others

Though, however, the efficacy of vaccination in protecting the individual is beyond question, it is by no means so certain that the great diminution of smallpox in western Europe in the closing years of the nineteenth and early years of the present century was due to wholesale vaccination, or that its communal efficacy is such that it may rightly be imposed upon reluctant people It seems fairly certain that compulsory vaccination in infancy, followed by periodical re-vaccinations in later life, if rigidly enforced with no exceptions of any kind, would obliterate smallpox in the inhabitants of Great Britain and render occasional importations from abroad innocuous But would it be worth while? The experience of Leicester shows that the frequent introduction of smallpox into a town where infant vaccination has been systematically neglected does not, in fact, lead to widespread and murderous epidemics It has also to be recognised that, on the modern standard of healthiness, vaccination is not a wholly negligible event It often leads to distasteful malaise, rarely to serious illness, very occasionally to death, and something of this price would doubtless have to be paid for complete security against smallpox The type, too, of smallpox which has been prevalent in Great Britain during the last few years (and which is possibly the indigenous English form) is quite a mild disease, not much worse than chicken-pox or even vaccinia This naturally makes people think more lightly of the disease than they used to, though it is obviously unwise to be sure that the mildness of type will never evolve into the form which caused the horrors of the eighteenth century, and still exists in the East and elsewhere, and is always liable to be brought into Great Britain

With such a conflict of considerations, public health administration plainly has a difficult problem to solve To abandon vaccination would save a few lives and a good deal of inconvenience, and it might lead to no harm on the other hand, it might result in serious disaster The majority will probably agree with those who prefer to be on the safe side

Hydrodynamics.

(1) *Grundlagen der Hydromechanik* Von Prof Leon Lichtenstein (Die Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen mit besonderer Berücksichtigung der Anwendungsgebiete, herausgegeben von R Courant, Band 30) Pp xvi + 506 (Berlin Julius Springer, 1929) 38 gold marks

(2) *Leçons sur l'hydrodynamique* Par Prof Henri Villat (Chaire de mécanique des fluides et applications, Fondation du sous secrétariat d'État de l'aéronautique) Pp viii + 296 (Paris Gauthier Villars et Cie, 1929) 50 francs

(3) *Hydro- und Aeromechanik nach Vorlesungen von L Prandtl* Von Dr O Tietjens Band 1 *Gleichgewicht und reibungslose Bewegung* Pp viii + 238 (Berlin Julius Springer, 1929) 15 gold marks

(1) THESE three books all deal with hydrodynamics, but differ widely in scope, and appeal almost to different types of mind Prof Lichtenstein, well known for his elegant investigations of some special problems, here undertakes a systematic survey of the science from a strictly logical point of view, incorporating an account of the researches on the existence-theorems of the subject on which he has been engaged for a number of years He submits to a rigorous scrutiny the various conceptions which lie at the base of the science, as well as the assumptions which have been made implicitly in its development This task is here essayed for the first time in the present connexion The classical writers and their followers have been accustomed to pass lightly over such matters and to be guided (often unconsciously) by physical intuitions rather than logical deductions In this they were entirely justified, for it is hard to see how they could otherwise have got on with their own primary business, to construct a mathematical scheme which should represent as well as might be the processes of natural phenomena But at length the pure mathematician comes into the field He is attracted by the interest and beauty of the mathematical structure which the classical writers have by degrees built up, but his keen logical eye detects flaws here and there, he is impelled to strive after precision where he finds vagueness in fundamental conceptions, and to supply *lacunæ* in the logical processes

This is the task to which Prof Lichtenstein has set himself in this book, which, he tells us, is the outcome of some six years' meditation It may be said at once that the result is worthy of the pains

bestowed The work is admirably arranged and lucidly written The arguments are of course highly technical and intricate, and not always easy to follow by a reader inexpert in the more abstruse departments of modern mathematics The easy-going 'intuitional' mathematician may be dismayed at the outset by a recital of definitions from the 'Mengenlehre', and may be astonished to find what a number of unsuspected assumptions he is in the habit of making when he talks lightly of a 'curve' or a 'surface', or even of a 'space' When he proceeds further he will find that the statements of theorems which have become familiar and almost obvious to himself are hedged about with a multitude of tedious limitations and restrictions But all this is no new phenomenon in the development of science, and is indeed of the nature of the case

One or two examples may be given of the kind of question here discussed Thus, suppose we have an unlimited mass of frictionless incompressible fluid, not necessarily homogeneous, at rest at infinity, and that it is in a prescribed state of continuous motion at a given instant t_0 The question is, Do the differential equations of hydrodynamics, without any appeal to experience, logically determine a definite and continuous state of motion for any subsequent instant t? The intuitionist has no hesitation about the answer, he is by nature a determinist, and is confident that his equations are adequate and consistent But it must be confessed that his faith rests on physical prepossessions rather than on strict deduction If he turns to the final chapter of the book, which is devoted to existence theorems of this and other more complicated types, he will find what a long and intricate process of reasoning is needed to establish the conclusion

Again, suppose that the mathematical equations involve some parameter which admits of continuous variation Does the motion which is governed by these equations vary in a continuous manner with the parameter? This question is raised, but not discussed in detail The author, indeed, states frankly that many questions still remain to be examined from the point of view of his treatise The case of compressible fluids, where mathematical discoveries of interest to the physicist are not impossible, is left aside The problems suggested by the theory of viscosity are in like case

Enough has perhaps been said to indicate the special character of the book But it should be added that the expositions of classical theory which are given incidentally as a text are extremely elegant, and are worthy of some attention from readers who may not wish to embark on the study of the intricate commentary

(2) The treatise of M Villat is based on a course of lectures given at the Sorbonne It deals with the various efforts which have been made to construct a strictly mathematical theory of the resistance which a fluid opposes to the motion of bodies through it The first to be considered is the two-dimensional theory of discontinuous motions originated by Helmholtz and developed by Kirchhoff, Rayleigh, and others The author discusses in detail the case of the flat lamina, following a method due to Levi Civita, and obtains of course the well known result of Rayleigh The theory in question had at one time a great fascination for mathematicians, on account of the power and elegance of its methods It will always retain a place in mathematical expositions, but its practical deficiencies have long been recognised It does not give the actual distribution of pressure over the faces of the lamina, and fails altogether to account for the suction in the rear to which most of the resistance is due

The rest of the work is devoted to an exposition of the interesting theory of Oseen This is a theory of slow motions, and only takes partial account of the inertia of the fluid On the other hand, viscosity is not ignored, though it is assumed to be infinitesimal More precisely, the investigation seeks to determine a priori the form which a solution of a particular problem might be expected to assume in the limit when $\mu \to 0$ Two special cases due to M Zeilon are here worked out, namely, the case of a hemisphere advancing with its flat, or with its curved surface in advance Here also there is a sharp discrepancy between the theory and experiment

M Villat's exposition is exceedingly clear, and is adapted to students who come to the subject with no great previous knowledge beyond the range of ordinary pure mathematics The various ancillary theories are discussed as occasion arises Thus we find a preliminary sketch of the theory of complex functions and conformal representation When Oseen's theory is approached we find a chapter on the theory of the potential M Zeilon's problems of the hemisphere, again, are prefaced by a brief account of zonal harmonics The book is thus logically complete, but it remains, alas, true that the student who wishes to get a physical insight into the mechanism of fluid resistance must have recourse to the experimental literature of the subject, with at present only imperfect guidance from pure theory

(3) In the third book on our list we come in contact with reality It is based on lectures given at Göttingen by Prof Prandtl, and is issued under his supervision and with his occasional collaboration It is expressly designed to form an elementary introduction to the classical hydrodynamics so far as this bears on practical questions The student is led on by easy stages from the fundamental conceptions to the final mathematical scheme The explanations are full and lucid, and illuminated by occasional touches which betray the master hand A word must be said in praise of the abundant diagrams, which though small in scale are exquisitely clear The volume is to be followed by another dealing more particularly with technical applications, including (it is to be presumed) the problems of aviation Already in the present volume a number of technical questions are touched upon by way of illustration Thus in the section on hydrostatics there is an interesting account of the statics of the atmosphere, the influence of moisture, the formation of clouds, and the behaviour of a balloon under various conditions At a later stage we have discussions on the efflux of gases, the flow round an aerofoil, and the trail of vortices shed by a screw propeller

The matter and style of the book are to be warmly commended, and not least to students whose approach to the subject has been hitherto mainly from the analytical side

HORACE LAMB

From Thales to Einstein

Two Thousand Years of Science the Wonders of Nature and their Discoverers By Prof R J Harvey Gibson Pp vii + 362 (London A and C Black, Ltd , 1929) 12*s* 6*d* net

THE lack of scientific knowledge among the general public is universally recognised and deplored in the world of science We may hope that the defect will be remedied in the next few generations, since science is now a part of all secondary school education and will doubtless permeate the elementary schools before many years are past At the moment, however, there is a very real need for books which will give the layman some acquaintance with science and its development without entering too deeply into points of technical detail Prof Harvey Gibson's book is a valiant effort to give a popular résumé of the history of science from the earliest times to the present day, and as such commands at least our admiration for its courage, even if we cannot unreservedly award it our full approval on all points

It is a melancholy task to review a book the author of which never lived to see it published Prof Harvey-Gibson, after a life whole-heartedly devoted to the pursuit of science and the propagation of scientific knowledge, unhappily died while the present volume was still in the early stages of its passage through the press Mr A W Titherley, however, upon whom fell the duty of bringing it into final shape, has striven to follow the spirit and intention of the author, and there is small likelihood that Prof Harvey Gibson would have made any extensive alterations

In his preface, the author says that he has tried to write a book of reasonable size which will give the general reader a sketch of the growth of science from early times, and in which he will also find an explanation, written in popular terms, of some of the principal subjects at present occupying the minds of scientific men It is an ambitious project, and the two aims are fulfilled with varying degrees of success To write a history of science in the small compass of three hundred and fifty pages is an undertaking before which the boldest might hesitate, and in point of fact Prof Harvey Gibson has not accomplished it What he has done is to give a brief account of some outstanding figures of science up to the eighteenth century, followed by a description of subsequent advances in physics, chemistry, biology, geology, and astronomy There is consequently a lack of balance about the book as a whole, the earlier sections being too short and disjointed to have any great value Thus Greek science is dismissed in twelve pages, while Roman science is omitted completely except for three incidental references to Pliny Arabian science is described in four short paragraphs, and even these contain such surprising errors as that the introduction of Arabic numerals was due to 'Ben Musa', presumably Al Khwarizmi

The first seventy pages of the book, dealing with science up to the eighteenth century, fall far short of the standard of the remainder They might profitably have been replaced by a general essay on classical and medieval science, which would have formed a much better introduction to the later periods than the somewhat staccato effect of the treatment adopted It is, indeed, abundantly clear that Prof Harvey Gibson did not feel at home in the earlier ages of science, but was anxious to arrive as quickly as possible to the more familiar and more fruitful later centuries With this transition, the level of the book rises steeply, the

material is selected with care and sound judgement, and the story runs smoothly and well. Particularly clearly in the biological sections, but adequately in all, the author brings out the essential features and shows the gradual unfolding of the flowers of science.

The twin aims of the book are never overlooked; Prof. Harvey Gibson was determined that the reader should not merely know about a discovery, but that he should actually understand the discovery. In some cases the explanation is necessarily compressed so much that the non-scientific reader will find the going hard, but, on the whole, the author has successfully anticipated and provided for the difficulties that inevitably arise. Any intelligent layman should be able to follow the arguments without undue mental strain, and it was for him that the book was written. Men of science may be expected to know something of the history of science in general and of their own branches of it, but if they wish to supplement their knowledge without devoting too much attention to minutiæ, they will find Prof. Harvey-Gibson an entertaining and well informed guide. It remains to be said that the book is well printed, but that the illustrations might have been more numerous and of better quality. E. J. H.

Photochemistry

Photo Processes in Gaseous and Liquid Systems. By Dr. R. O. Griffith and Dr. A. McKeown. (Textbooks of Physical Chemistry.) Pp. viii + 691. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1929.) 25s. net.

IT has been stated, possibly with truth, that any investigations performed by chemists which prove to be of more than passing interest are rapidly assimilated by and incorporated in physics. This stage appears to have been reached in the subject of photochemistry, ably dealt with by Drs. R. O. Griffith and A. McKeown in "Photo Processes in Gaseous and Liquid Systems", published in the well known Longmans Green series of text books on physical chemistry, edited for so long by the late Sir William Ramsay, and now under the genial direction of Prof. F. G. Donnan.

It is clear that, in order to gain an insight into the reasons why absorbed light causes an atom or molecule to become chemically reactive, it is necessary to find out what is the fate of the absorbed energy and what changes in the molecular electronic, vibrational or rotational energies take place as a result of such absorption, and in what manner these may be interdependent, before one can state definitely that chemical reactivity is imparted by such and such a change in the molecular system. This the authors have clearly recognised, for they have devoted no less than half the volume, which contains six hundred and eighty pages, to such considerations. This section of the book is conveniently divided into five chapters, commencing with a classification of spectra, the Bohr theory of spectral lines, the spectra of atoms including transition probabilities and lives of excited and metastable atoms.

Chapter iv. is devoted to the more complex case of molecular spectra, which introduces naturally the subject of fluorescence. It is only natural that in such a rapidly growing subject any book written will be 'dated' at the time of publication. Whilst the authors have kept well abreast of the times in many sections of the subject matter in this portion of the volume, in others information anticipated in a volume published in 1929 is not to be found. Thus the section on rotational and vibrational molecular spectra might well have been amplified. The statement (p. 33) that "the infra red bands of carbon monoxide and of carbon dioxide are not capable of complete resolution" must certainly be regarded as somewhat sweeping. Whilst on page 54 some space is devoted to the Compton effect as evidence for the existence of the light quant or photon, it is somewhat curious that the analogous effect discovered by Raman, which has proved of such value in the determination of infra-red molecular spectra, is not even mentioned, although it is now common practice to employ the Raman effect for the identification of lines in the infra red molecular spectrum.

In discussing the optical convergence limits for the diatomic gases such as nitrogen, oxygen, and the halogens, with the object of determining the heats of dissociation, it is somewhat unfortunate, on account of the frequency with which they are used in thermochemical calculation, that in both nitrogen and oxygen figures more recent than 1926 have not been employed; the values given are certainly much too high. The chapters on fluorescence and chemiluminescence are full of interesting information; in the latter the oxidation of dyestuffs such as safranin by ozone might have been included just for the sake of its beauty and suitability for lecture demonstration purposes.

In the second portion of the book, two chapters are devoted to the Stark Einstein law of photochemical equivalence, the experimental confirmation of which was commenced by Warburg; one

to the still mysterious chlorine-hydrogen and chlorine-carbon monoxide reactions, and one to the important phenomenon of photosensitisation The last chapter includes a discussion on the temperature coefficient of photochemical reactions and phenomena resulting from the intrusion of catalysts in photochemical reactions It is interesting to note (p 556) that the authors do not favour the concept of an excited chlorine atom as being the link in the atom chain mechanism so long sought for in the hydrogen chlorine combination, although recent work from Semenoff's laboratory lends additional support to this view The treatment, however, in this portion of the book is very fair to the diverse views which have been expressed, and the criticism which is presented from time to time by the authors is both pertinent and stimulating The authors are to be congratulated on writing what may well be considered the standard text-book in this growing subject

ERIC K RIDEAL

Our Bookshelf.

The Glorious Oyster his History in Rome and in Britain, his Anatomy and Reproduction, how to cook him, and what various Writers and Poets have written in his Praise, collected together as an Acknowledgment of the Supreme Pleasure he has given to all Persons of Taste since Roman Times By Hector Bolitho With certain Chapters edited by Maurice Burton Pp x + 203 (London and New York Alfred A Knopf, 1929) 6s

THIS small book is " written merely as a record of those stories of the oyster of which the author has read, brought together as a tribute to *his* (the oyster's) importance ", and in fulfilment of a long standing vow to write such a book The author's confessions provide a key to the product In historical quotations on the oyster in Rome and Britain (many culled from Philpots, " Oysters and All About Them "), in references to curious habits and an anthology, the author finds a congenial topic, and has collected within a small compass a number of stories and references likely to be of interest to those readers who browse, to some who read lightly, certainly to those who have an affection for the oyster, or who want to find one of the less well-known stories The subject, however, is not treated exhaustively or seriously In an interesting quotation dated 1859 (occupying thirteen pages, and from " All the Year Round ", edited by Charles Dickens) it is recorded that 800 oysters were taken in one dredge haul off Whitstable, where an equivalent catch of all sizes nowadays would probably be a good one if twenty were taken

The author is, unfortunately, not successful in his treatment of reproduction, enemies, and cultivation, in spite of the fact that contributions to these subjects were made by Mr Burton It is apparently a very difficult matter for a (presumed) layman to write on a scientific subject even when provided with the subject matter For example, he writes " As time proceeds, each of the embryos constituting the black spat develops a crown of protoplasmic hairs or cilia and becomes known technically as a ' trochosphere ' larva " The author is amusingly unaware that he is describing the development of the oyster backwards The fall of spat is stated to occur usually in May ! A single oyster is quoted as producing from 300,000 to 60,000,000 eggs in a sentence sandwiched between two others referring to the European oyster It is stated that ' hockling ' is a prevalent and familiar disease, that the mantle is a tough fleshy plate of tissue, that oysters cannot live in water which contains less than three per cent of salt, while a native oyster is still believed to be " one which is or has been bred on or near the Thames Estuary " After quoting Goldsmith on oysters, the author states ' This quotation illustrates the ignorance concerning oysters existing as recently as when Goldsmith was alive " J H O

Thermodynamik die Lehre von den Kreisprozessen der physikalischen und chemischen Veränderungen und Gleichgewichten, eine Hinführung zu den thermodynamischen Problemen unserer Kraft- und Stoffwirtschaft Von Prof Dr W Schottky In Gemeinschaft mit Dr H Ulich und Dr C Wagner Pp xxv + 619 (Berlin Julius Springer, 1929) 56 gold marks

THIS is an interesting and important book, of which at least parts will be of use to all teachers of thermo dynamics The fundamental principles of the subject are dealt with at considerable length, and difficulties are not glossed over but fully discussed

An important aim of the book is to retain the advantages of the analytical method of Clausius-Gibbs-Planck while avoiding the possible obscurity of the characteristic functions, and to retain the close touch with experimentally measured quantities of the cycle method of Helmholtz-van 't Hoff-Nernst while avoiding its clumsiness New coefficients, called heat and work coefficients, are introduced which have a close and obvious connexion with the measured quantities of heat and work At the same time, these coefficients are shown to depend only on the state of the system and their relation to the older characteristic functions is worked out Although at a first reading the new notation is rather confusing, it is an advantage where possible to have experimentally measured quantities in the equations In this connexion reference must be made to the large amount of information concerning the relations between experimental quantities that, with the new notation, is compressed into the two small tables on pp 77 and 78 Whether the new method will appeal to students more than the old can only be found by trial

Another important point is the development of the ideas of Gibbs on the components of a system in a natural and helpful way by the introduction of the conception of resistant groups The appli-

cations of thermodynamics to homogeneous and heterogeneous chemical systems are considered at length

From the point of view of the teacher who decides to use the new method, it would have been better to arrange the book so that the possibilities of classical thermodynamics were more fully exploited before the introduction of the Nernst heat theorem Also the eighteen numerical applications would be better in the main text, and considerably increased

The History of British Civilization By Dr Esmé Wingfield Stratford Second edition, revised Pp xix + 1332 (London George Routledge and Sons, Ltd, 1930) 15s net

IT is very satisfactory to see that Dr Wingfield Stratford's work, reviewed in NATURE of June 8, 1929, p 863, has already reached a second edition in one volume The price of the first edition in two volumes was the only obstacle to the wide popularity of the book, the price of the second removes that difficulty, for no one can 'boggle' at 15s for 1300 large and well printed pages

The book is certainly a godsend, for repeated trials on the average intelligent person have convinced us that it has just the elements needed for success—a very wide reading on the part of the author, a generous and impartial spirit, a lively style, a strong personal interest, and a burning enthusiasm for his country It is not an elementary history for schools, it is not a scientific history, based on documents and adding to our knowledge, but it is a real book, adding to our interest and bringing together, from a new and personal point of view, a multitude of facts and personalities of which most people have some vague and often disconnected knowledge

When one considers the vast importance of the subject and its growing complexity, this is great service to the public, and one should be duly grateful to Dr Wingfield-Stratford for having done it so zealously It may be confidently expected that this book will attain to late editions, and, if so, he may find opportunities to make good some of the defects we pointed out in an earlier notice This edition is practically a reprint of the first F S M

Hindu Exogamy By S V Karandikar (University of Bombay Publication) Pp xv + 308 (Bombay D B Taraporevala, Sons and Co, 1929) 6 rupees

IN attempting to formulate a theory of Hindu exogamy, Mr Karandikar has attacked a subject of considerable intricacy, and if his book is difficult the fault is not to be attributed to the author He seeks to extract the evidence for exogamy from the earliest Sanskrit literature and to trace its history and development through the later documents, while at the same time comparing or contrasting it with the practice in Indian culture Owing to the general dissociation of the study of Sanskrit literature from anthropological studies, the subject is not one which hitherto has been attacked on these lines It would appear that among the Aryan invaders, exogamy was not practised Indeed, the union of close kin was encouraged The present exogamy of the Indo Aryans is derived from the *gotra*—sept or clan—a word which occurs a few times only in the Rig-Veda On the other hand, there appears to have been a form of *sapinda* exogamy based upon the generations on both the father's and the mother's side Mr Karandikar has traced the development of these forms of exogamy from early times and shows how, by a process of admixture and borrowing as between Aryan and Dravidian stocks, the forms of exogamy as at present practised in India have come about He concludes with some considerations of the eugenic aspect of the practice on the population of India

Bandenspektren auf experimenteller Grundlage Von Dr Richard Ruedy (Sammlung Vieweg, Hefte 101 102) Pp vi + 124 (Braunschweig Friedr Vieweg und Sohn A G, 1930) 9 60 gold marks

THIS famous series of monographs has now added to its number an excellent little volume on band spectra by Dr Richard Ruedy of Toronto This appears at a time when rapid progress is being made both on the theoretical side by Hund, Mulliken, and others, and on the experimental side by a large number of workers in many countries The foundations of the subject are, however, sufficiently well established to justify a volume of this scope, and it should prove a trustworthy and valuable introduction to the whole subject of electronic band spectra, especially for those who have not previously had any specialised acquaintance with the subject

This book to some extent covers the same ground as Mecke's article in the 'Handbuch der Physik", vol 21, but there is ample scope for several presentations of the subject by men who can write authoritatively Dr Ruedy has managed to compress into moderate space a very lucid and attractively arranged account of the basis of this difficult subject

Physikalische Beiträge zur Radium emanations therapie Von Heinrich Mache und Stefan Meyer (Abhandlungen aus dem Gesamtgebiete der Hygiene, herausgegeben von Prof Dr R Grassberger, Heft 5) Pp 32 (Leipzig und Wien Franz Deuticke, 1929) 2 40 gold marks

IT is commonly supposed that thermal waters possessing radioactive emanations exert therapeutic action due to the emanations, but definite data concerning this are difficult to find. The authors of the two papers contained in this memoir give the results of investigations on the entrance into the body of the radioactive emanations of the Gastein thermal waters by bathing, by drinking, and by breathing air containing them By drinking and by breathing, the emanations rapidly enter the blood, but are quickly eliminated, though it is questionable if the emanations can enter through the skin by bathing Quantitative data are given of the amount of the emanations found in the blood and of the rates of accumulation and elimination of the emanations

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

Curling.

WE should like to direct attention to the question of what can be learnt about ice friction from the well-known behaviour of a curling stone

A stone laid tee high has a run of 42 yards It has spin (called handle), which remains almost constant until near the end of the run The total lateral divergence of the stone, from the straight line on which it is laid by the player, is called the borrow Clockwise spin (in handle) causes divergence to the right, the opposite spin (out handle) causes divergence to the left Spin is necessary, because a stone laid without spin is at the mercy of any slight irregularity in the ice which may catch one side of it Ordinarily, the spin is between 3 and 5 complete turns in the run of 42 yards Between these limits the borrow is not much affected by the amount of the spin, probably it is affected a little, increasing slightly with increased spin But a substantial increase of the spin beyond this range decreases the borrow, and

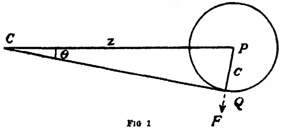

FIG 1

by giving a very heavy spin a nearly straight path can be obtained Sweeping in front of a stone, which on good dry ice reduces friction, at the same time delays or reduces the bending of the path

Sir Gilbert Walker has remarked that the direction of the borrow requires that the friction at the back edge of the cup, on which the stone runs, should be greater than at the front edge, and that, in consequence of retardation, the pressure between the stone and the ice is greater in front than behind But we have not been able to hear of any attempt to consider the borrow quantitatively The following calculation for a simple case will show the way in which we have attacked the problem

Suppose the total friction to be constant, and applied in the way most favourable to curvature of the path, and let us deal only with the first 40 yards of the run By the omission of the last two yards we avoid complications introduced at the very end of the run, and this is found, in our calculation, to be sufficient to provide that we are dealing with a portion of the run in which the angles involved are small angles the squares of which are negligible

Let P be any point in the first 40 yards of the path of the centre of a stone laid tee high Let C be the instantaneous centre of the motion, and Q the point of contact of a tangent drawn from C to the cup Then PCQ is a small angle, θ We assume that the friction at any point acts in the direction opposite to that in which the point is moving, but we do not know how it is distributed round the cup Let us take the extreme case in which it is concentrated into a single force, F, at Q, in the direction of PQ We will assume this force to be constant We write F for $F\cos\theta$, and the force along the normal to the path is $F\sin\theta$, or $F\frac{c}{z}$, where c is the radius of the cup, and z is written for CP Let M be the mass of the stone, τ the whole time of the run, and l the whole length, s the length of the path measured backwards from the tee up to P, ψ the inclination of the tangent at P to the line on which the stone was laid, y the distance of P from this line, ρ the radius of curvature, v the velocity of the centre of the stone, f the tangential component of the retardation, and ω the angular velocity, which must be constant within our range Then the following equations seem to be nearly correct

$$Mf=F, \quad l=\tfrac{1}{2}f\tau^2, \quad v^2=2fs, \quad \frac{v^2}{\rho}=f\frac{c}{z}, \quad v=z\omega,$$

$$\frac{1}{\rho}=-\frac{d\psi}{ds}, \quad -\frac{dy}{ds}=\sin\psi$$

Thus we get

$$-\frac{d\psi}{ds}=\frac{fc\omega}{v^3}=\tfrac{1}{4}c\omega\tau l^{-\frac{1}{2}}s^{-\frac{3}{2}},$$

and, by integration,

$$\psi=\tfrac{1}{2}c\omega\tau l^{-\frac{1}{2}}(s^{-\frac{1}{2}}-l^{-\frac{1}{2}}),$$

and writing $\sin\psi$, or $-\frac{dy}{ds}$, for the small angle ψ, and integrating again,

$$y=\tfrac{1}{2}c\omega\tau l^{-1}(l^{\frac{1}{2}}-s^{\frac{1}{2}})^2$$

With a cup of $4\frac{1}{2}$ inches diameter, and a spin of 5 turns in the length of the run, the value of $\frac{1}{2}c\omega\tau l^{-1}$ is about 0 025 Thus the value of y at a point 2 yards short of the tee is 1 ft 11 in (At this point θ and ψ are about 0 1)

This is a disconcerting result No reasonable correction of the point from which s and l are taken to be measured alters the general character of it The calculated borrow might perhaps be accepted for average conditions, but it is much too small to admit allowance for variation of the data To account for the facts, it seems to be necessary to suppose that increased spin tends (in some way not explained) to equalise the friction in front and behind, and thus counteract the effect of the increased value of ω But by putting all the friction behind, with a spin of 5 turns, we have not left room for this, nor for the occasional occurrence of borrow of exceptional magnitude

There remains the question whether it is approximately correct to take the total friction to be constant during the run We know its average value, the question is whether it increases to a value substantially above the average as the velocity decreases In several successive years, so far as we have had occasional opportunities, we have tried to test this But our results have not shown this variation, indeed, our records have a slight tendency to show a little decrease of friction at the point at which increase is most wanted We began by using stop watches, but eventually we had a suitable electric chronograph, and stretched threads across the ice, the slightest twitch of which made an electric contact Thus we have some fairly accurate records

We have also used a dynamometer to test the relation between total friction and pressure For various reasons this could not be used so as to give very accurate results, but it showed that if a stone was loaded so as to increase the pressure by varying amounts up to 40 per cent, the total friction was nearly constant Doubled pressure gave a considerable increase of friction A consistent variation of

10 per cent would not have escaped notice The friction thus measured, when a stone was towed at a foot's pace, agreed roughly with that shown in an ordinary run of a stone

It seems clear that we have failed to take account of some important feature of the motion What is it ?

W H MACAULAY

King's College, Cambridge

G E SMITH

Cherry Tree Lane, Woodbridge,
Feb 18

Gaseous Combustion

I AM greatly indebted to Prof Bone for the very clear exposition of his views in the issue of NATURE for Feb 22 I think, however, that a serious mis understanding has arisen which I should like to try to make clear

In the letter in NATURE for Jan 25 from Mr Davies and myself, it was stated that our new experiments suggested the analysis of the overall process of com bustion into two broad stages

(1) The combination (and of course the main) stage, resulting in the formation of molecules of carbon dioxide and water of abnormal structure, during which the energy released is $H - x$, where H is the heat of combustion

(2) The passage of these molecules of abnormal structure into normal molecules during which energy x is released (While x cannot be a large proportion of H, the platinum wire experiments mentioned in our letter suggest that it is of appreciable magnitude)

The misunderstanding mainly arises, I think, in the matter of time scale The second stage—if the suggested analysis is to explain our experiments—must be regarded as being one of extraordinarily long duration when combustion takes place in the gaseous phase As indicated in our letter, we appear to have traced its existence for so long as 14 seconds after maximum pressure in an explosion, and we have little doubt that we could trace it for a much longer time with new apparatus

Assuming the correctness of this view, it will be clear that in ordinary explosion experiments, in which measurements are rarely, if ever, made later than one second after maximum pressure, this stage, so very slowly does it progress, may for many purposes be disregarded and the explosion regarded as one in which energy amounting to $H - x$ approximately is released It is, for example, disregarded in this manner in the coal gas explosion experiments men tioned by Prof Bone, from which I estimated that about 10 per cent of the gas is unburnt at maximum pressure, for the method adopted was roughly that of comparing the energy at the moment of maximum temperature in a weak mixture explosion with that remaining in an exploded strong mixture after it had cooled to the maximum temperature of the weak mixture, and the cooling to this temperature took only about $\frac{1}{4}$ sec Thus the estimate of 10 per cent unburnt gas (which should now be amended to the slightly different value 10 $H/(H - x)$ per cent) derived from these experiments refers only to incompleteness of the first stage The experiments further appear to indicate that burning in the weak mixture is also complete in this sense in about $\frac{1}{4}$ sec after maximum pressure (*Proc Roy Soc*, vol 98, p 313)

While Prof Bone is somewhat doubtful as to the duration of what we have termed the second stage in the overall process of combustion, I think I am right in my interpretation of his letter in assuming that the main difference of opinion between us is in regard to the way in which this 10 per cent (or rather 10 $H/(H - x)$ per cent) is to be accounted for My view in regard to this is unchanged, I believe that it is to be accounted for in terms of uncombined gas Prof Bone believes that it is to be explained in terms of excess energy concentrated in the vibratory and rotational degrees of freedom of the freshly formed molecules I fully admit that, in the absence of chemical analysis, my view must remain a hypothesis, but I prefer it to his view for the reason he mentions, namely, that I think par titioning at explosion temperatures must be very rapid, and also because my experiments indicate that the radiation at the maximum temperature in a weak or medium mixture is very little greater than that from a strong mixture when it has cooled to this temperature Such small difference as there is may be readily explained in terms of the greater tem perature variation in exploded gases at the moment of maximum temperature than some time later, and also of the higher transparency of the gases at that time (*Phil Trans* A, vol 211, pp 386 and 398, and *Proc Roy Soc*, A, vol 98, pp 189 and 195) Further more, I find less difficulty than ever in believing in the reality of incomplete combination at maximum pressure in ordinary explosions since Prof Bone has published his analyses of the cold products of dry carbon monoxide mixture explosions He shows that in these very stubborn mixtures there is a large pro portion of carbon monoxide in the products after ex plosion, although the flame during the explosion period had completely traversed the mixtures and the time interval during which combination could take place was very much longer than the interval from ignition to maximum pressure in ordinary explosions

The main object of our letter published in NATURE for Jan 25 was to suggest that what we have called the long drawn out second stage in the overall process of combustion is a possible explanation of our lumin osity and platinum wire measurements As already stated, we found that in a large explosion vessel (18 inch sphere) silver plated so as to arrange for as slow cooling as possible, the luminosity in a 30 per cent moist carbon monoxide–air mixture at 3 atmospheres density remained visible to the eye for at least 14 sec after maximum pressure, that is, until the temperature had fallen to about 300° C I believe Prof Bone has a high pressure explosion vessel fitted with a quartz window, and it would be of great interest if he could indicate the duration of luminosity after maximum pressure in a high pressure explosion and also give an estimate of the temperature at which luminosity disappears If, as seems reasonable to suppose, the second stage is speeded up in a high density mixture, the temperature at which luminosity ceases to be visible to the eye should be higher than 300° C

If the second stage can be shown conclusively to exist, it is of interest to note that an internal com bustion engine exhausts the working fluid with its carbon dioxide and water molecules in the abnormal condition, and, if x is appreciable, an appreciable amount of energy is thereby wasted A window fitted to the exhaust pipe of a gas engine shows that the ex haust gases (temp 500° C 600° C) are luminous, though chemical analysis fails to detect uncombined gas

Exceedingly interesting information can be collected from the literature of the internal combustion engine in this connexion For example, Hopkinson, by means of an exhaust gas calorimeter, found in the exhaust gases actually more heat that he deduced from the temperature (as inferred from the pressure) of the working fluid in the cylinder at the end of the explosion-expansion stroke, in spite of the fact that the opinion is firmly held that as much as 10 per cent of the heat of combustion of the charge is lost to the cylinder

walls and the exhaust valve during the exhaust stroke, and has therefore been extracted from the working fluid before it reaches the calorimeter (Scientific Papers, pp 272 and 288)

This would, of course, yield a very high value for x—much higher than I should have thought possible It is right, however, to add that although Hopkinson's experiments relate to the same engine and are given in the same paper, he does not appear to have correlated the two sets of figures But even so, after making large allowance for possible experimental error, we are still left with a value for x which suggests its very real practical importance

W T DAVID

Engineering Department,
The University, Leeds,
Feb 24

Australian Origin of Red Rain in New Zealand

WE have recently had two striking examples of the manner in which the influence of a continent may extend, in ways which might easily be overlooked, to enormous distances round about it It is well known that in dry years large quantities of smoke from bush fires in Australia are carried by the south east monsoon over the East Indian Archipelago On Oct 25 and 26, 1929, however, dense haze, which can have had none other than an Australian origin, was seen at the Island of Niue in lat 19° S, long 170° W, 2300 miles distant from Australia The meteorological observor, Mr J P McMahon-Box, reports that "A strange smoky haze enveloped the whole Island on the 25th and 26th It came up about midnight on the 24th to 25th, apparently from the south west, in which direction it was densest Visibility was very poor indeed It disappeared during the night of the 26th to 27th We experienced a couple of thunderstorms during the period of the haze "

On reference to the weather charts, it is found that on the morning of Oct 22 a rather intense anticyclone was centred just west of Tasmania, while a deep cyclone had developed in the Tasman Sea Strong south west or southerly winds were blowing over eastern Australia, where there had been little rain It is probable that dense masses of bush fire smoke mixed with fine dust started on the journey to Niue on that day During the following days the cyclone moved eastward, its track curving round to the north of New Zealand At 9 A M (New Zealand time) on Oct 24 its centre was in about 32° S and 178° E, the pressure being below 29 10 inches The strong west to south winds in the north west quadrant of the cyclone made conditions ideal for the transport of dust and smoke from Australia to the Pacific Islands It is worth noting that thunderstorms were reported near the centre of the cyclone on both Oct 22 and 24, when vessels happened to be favourably situated

The second phenomenon was recorded in New Zealand on Nov 27, when copious deposits of red dust, such as is found in the interior of Australia, were brought down by rain over a wide area covering the Marlborough, Nelson, and Taranaki Provinces, and the portion of the Wellington Province lying to the west of the mountain ranges Flowers, washing, motor cars, etc , were stained a pale chocolate colour Many observers noted that the clouds had a reddish brown appearance and some severe thunderstorms occurred Several samples of the dust were sent to the Meteorological Office Another interesting sample was forwarded by Mr A C Jones, the second officer of the M S *Taranaki* This was found adhering to damp structures on the vessel when 190 miles from the Australian coast on Nov 23 The vessel was in dust haze when between the following positions, 39° 43′ S , 151° 4′ E , and 39° 56′ S , 152° 43′ E

On this occasion again the dust was brought to New Zealand by the winds in the north west quadrant of a complicated depression which moved across the Tasman Sea between Nov 23 and 28 This depression was at first of the inverted V type, but afterwards two cyclonic centres developed in the northern portion One of these disappeared, and by Nov 27 a deep cyclone was centred off the south west coast of the Dominion

At Reefton, in the Nelson Province, a slight sediment was left by the rain on Sept 4, 1929

The most notable deposit of dust from Australia on New Zealand occurred, however, on Oct 6–10, 1928, and is described in papers by Dr P Marshall and myself in the *New Zealand Journal of Science and Technology*, vol 10, No 5, pp 291 99, 1929 Following on that occurrence the snow for many miles, probably 200 to 300, along the main ranges of the South Island, was for months stained a pale chocolate colour On Ben Lomond, near Queenstown, in Otago, at the end of October, I found the snow impregnated with the dust in a layer about five inches thick From the amount of snow I was able to carry away in a hand kerchief, more than 4 grams of deposit were collected 200,000 tons is a conservative estimate for the weight of the total deposit on New Zealand in this fall On this occasion, also, thunderstorms were numerous and very violent, and it seems certain that the suspended dust is, in part at least, responsible for their development

It will be seen that dust storms of the nature described may, in the course of time, be responsible for a red sediment of no inconsiderable thickness on the floors of the Tasman Sea and the Pacific Ocean

EDWARD KIDSON

Meteorological Office, Wellington,
Dec 27, 1929

THE sample of red rain dust collected at Ben Lomond, near Queenstown in southern New Zealand, by Dr Kidson, which the Editor has kindly sent me for inspection, agrees in its microscopic characters with falls previously described It contains some coarse quartz grains, doubtless of local origin, but the bulk is a fine clay and silt such as is common on the dry lake beds of the interior of Australia , it contains some diatoms and shreds of algæ, which look like those that grow in the pools in such localities

The red rain that falls in Victoria acts as an indelible stain on fresh paint, and that which fell on Feb 14, 1903, was proved by F Chapman and H J Grayson (*Vict Naturalist*, vol 20, pp 17 32, pl i, ii, 1903) from the diatoms to be derived "from the swamps and salt lakes which fringe the River Murray and its tributaries " and from other rivers in South Australia These authors proved the same origin for some material which I obtained in southern New Zealand, which must have travelled in the air for more than 1000 miles , this record was given in my " Geography of Victoria ", p 264

I cannot determine the diatoms in Dr Kidson's sample , but the character of the material is strikingly like that of the lake plains of Lakes Eyre, Callabonna, etc , in South Australia, and fully supports Mr Kidson's conclusions This record is of interest not only as of another occurrence of his widespread dust distribution, but also from his estimates of its quantity.

This red dust no doubt contributes to the red clay of the deep sea , but that material covers so vast an area, and often lies so far from any likely source of desert supply, that the abysmal red clay is probably

in the main derived from other sources The red clay of the Tasman Sea may be largely composed of this desert dust, and its comparison with that from the central Pacific would be of interest

I have not yet had the opportunity of seeing the recent paper in the *N Z Journal of Science and Technology* referred to by Dr Kidson

Black snow and black rain fall in the south west of Scotland, but when some of this was sent to Glasgow, it was determined by Mr B K N Wyllie as due to particles of slag from the Cumberland iron works (*Scottish Ski Club Magaz*, January 1912, pp 153 5)

J W GREGORY

The Present Status of *Drosophila melanogaster*

DURING more than two decades *Drosophila melanogaster* has occupied a prominent position in connexion with developments in biological theory Its extreme variability was noted in 1906 by Castle, and its peculiarities in this respect were later exploited by Morgan and his associates in a long series of publications On account of the great ease with which this fly can be maintained in cultures and of the short life cycle, it has proved most convenient for genetical investigations Apparently, experimental work excites a disproportionate degree of credence at the present time in connexion with biological theories Experimental work, from the evolutionary point of view at any rate, by itself alone, appears to have a definitely restricted value

It has been known ever since Rosenberg's truly epoch making investigations on the cytology of the hybrid between *Drosera rotundifolia* and *D longifolia* that there are certain cytological characteristics which are of fundamental importance in connexion with the study of hybrids between species Starting with his work on the hybrid between these two species, commonly known as *D obovata*, Rosenberg was led to extend his observations to variable species in Nature, notably the genus *Rosa* as represented by the dog roses of Europe Similar observations have been carried out in my laboratories on other genera of the Rosaceæ, namely, the extremely variable and exceedingly numerous American species of the genus *Cratægus* and of the equally variable American blackberries Further observations carried on in the southern hemisphere in the case of the huge and variable genera *Eucalyptus*, *Acacia*, and *Veronica*, show that this condition is not confined in any way geographically, but is a feature commonly exemplified by large genera This state of variability in large genera was prophetically pointed out, many years ago, by Charles Darwin in the "Origin of Species"

Those species which are the favourite material of genetical experimenters at the present time are species which have all the variability of hybrids This condition has long been recognised in the case of the species of the genus *Œnothera*, which was brought into prominence more than two decades ago by De Vries There are now scarcely any students of the genus who do not admit that its species are very largely contaminated by hybridisation On the botanical side the idea of widespread hybridism in Nature is more and more hospitably received On the zoological side we find, however, a much less degree of cordiality towards this idea It is strongly maintained by many geneticists, for example, that *D. melanogaster* is a good species, and one of the pieces of evidence cited in this connexion is that it does not readily cross with other species of the genus. This turns out to be an untrustworthy criterion, however, because cases are known on the botanical side of experimentally produced hybrids which will not back cross even to their own parents

In 1925 the present writer, in collaboration with Prof G C Hicks, published [1 2 3] a number of observations on the meiotic or maturation division in the male gonads of *D melanogaster* These observations were rendered possible by the development of methods which made it feasible to examine a huge amount of material with a minimum amount of effort The investigations showed clearly that the reduction division in *D melanogaster* presents all the peculiarities of those found in natural or experimentally produced hybrids In 1928, Belar [4] published some photomicrographs which, according to his view, showed the inaccuracy of the observations made by the present writer and Prof Hicks Belar's figures of the division of the primary spermatocytes, however, show a distinct lagging of the chromosomes in the maturation division, which is recognisable by all who are familiar with the cytology of hybrids as a distinct criterion of hybrid origin Very recently Zuitin has published in the *Bulletins* of the Bureau of Genetics of Leningrad (vol 7, 1929) an account of the reduction division in this species His results confirm the accuracy of the observations made by Prof Hicks and the writer, inasmuch as he figures the abnormalities described in our papers published in 1925 He reaches the conclusion, further, that *D melanogaster*, as he puts it, has the cytological abnormalities of "special [obviously the meaning is interspecific] hybrids"

It will be obvious to the reader that *D melanogaster* as an object of genetical investigation must be subject to all the reservations which should be made in the case of the study of hybrids Probably the reluctance of geneticists in general to admit the hybrid origin of *D melanogaster* arises out of the fear lest either the Mendelian hypothesis or the chromosome theory of heredity should be thereby compromised It is also important to note that not only breeding experiments with *D melanogaster* are open to such criticisms as would arise from the hybrid character of the material, but also the investigation of this and other variable species by means of radiations is likewise open to grave question Another prominent weakness of actinic experimentation in connexion with theories of the origin of species is the fact that there is no reason to suppose that such radiations have any important influence in moulding species in Nature

E C JEFFREY

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[1] Jeffrey E C "*Drosophila* and the Mutation Hypothesis" *Science*, vol 62, No 1592, 1925

[2] Jeffrey, E C, and Hicks, G C "The Reduction Division in Relation to Mutation in Plants and Animals" *American Naturalist*, vol 59, 1925

[3] Jeffrey, E C, and Hicks G C "Evidence as to the Cause of So-Called Mutations in *Drosophila*" *Genetica*, 7, 1925

[4] Belar, "Die cytologischen Grundlagen der Vererbung" Handbuch der Vererbungswissenschaft Berlin, 1928

The Water Balance of Plants as a Factor in their Resistance to Insect Pests

As a result of a review of the available evidence with regard to the effect of climatic and soil conditions on the distribution of the *Dysdercus* sp, the hypothesis was put forward by one of us (E P M) in 1925–26 that a disturbed water content, from whatever cause, rendered the cotton plant more susceptible to the attack of sap feeding insect pests, such as various species of thrips. Later it was found that this hypothesis appeared also to hold true in the case of certain sap feeding insect pests of sugar cane, notably the

froghopper *Tomaspis saccharina* Dist So far as cotton is concerned, the hypothesis has since been confirmed by observations made in the field in California

In the autumn of 1926 several extensive tours were made into the cotton growing regions of California, which included not only the well-known Sacramento, San Joaquin, and Imperial Valleys, but also the lesser known Ferris, Coachella, Palo Verde, and Barde Valleys At that time more than 160,000 acres of cotton were growing in California proper, an additional 130,000 acres occurring in Lower California It was then found that thrips (*Heliothrips fasciatus* Perg) attack on Acala cotton invariably followed faulty irrigation practice Thrips were never found in large numbers on plants receiving an optimum water supply It seemed that plants suffering from water shortage were definitely more attractive to the attacking thrips

W B Camp, of the U S Bureau of Plant Industry, working in collaboration with the Department of Agriculture, has been carrying out a series of experiments on these lines for a number of years, and we have reason to believe that this hypothesis is supported and extended by the results of his researches It also receives support from Bedford's observations on thrips (*Heliothrips indicus* Bagnall) attack on Egyptian cotton in the Sudan (*Wellcome Trop Res Lab*, *Khartoum, Ent Sec Bul*, **18**, 1921), though in some respects it would appear to be contradicted by Wardle's observations on *Thrips tabaci* Lind attack on cotton in a Manchester greenhouse (*Ann App Biol*, **14**, 482, 1927 Compare also MacGill, *ibid*, **16**, 288, 1929)

With regard to the sugar cane froghopper (*Tomaspis saccharina* Dist), the hypothesis has also received striking confirmation in practical experiments by Withycombe (*Ann App Biol*, **13**, 64, 1926 *Proc Agric Soc Trinidad and Tobago*, **26**, No 6, 294, 1926) and other workers in the West Indies Increasingly we are led to believe that the hypothesis holds true for a large number, but not all, species of thrips, red spider, etc, as pests of a wide range of food plants Several cases are cited by Lees (*Ann App Biol*, **13**, 506, 1926) in which heavy irrigation and heavy rain fall resulted in increased susceptibility to insect attack, but it is not improbable that, in a number of cases, conditions of physiological drought were present as a result of deficient soil aeration

It seems also that the nitrogen content of the sap is an important factor with regard to susceptibility to attack This has been referred to by Davidson (*Ann App Biol*, **10**, 35, 1923) and by Lees (loc cit) Experiments carried out by one of us (E P M) on the curly top disease of the sugar beet in California, transmitted by the leafhopper *Eutettix tenellus* Bak (results to be published shortly in *Annals of Applied Biology*), point in a similar direction There is, indeed, much evidence available which indicates that a highly nitrogenous diet stimulates reproduction The two factors, water content and the nitrogen content of the sap, are interdependent, but it would form an interesting problem in nutrition to find which of the two is of the greater importance in any particular case

The specific rôle of water in the metabolism of plant and insect is not mentioned by Uvarov in his recent memoir and review of the literature on insect nutrition and metabolism (*Trans Ent Soc*, *London*, Pt 2, December 1928), although considerable attention is paid to the related subjects of the food of insects and the influence of diet on growth and reproduction There is also no reference in "Filterable Viruses" (Ed by T M Rivers, Baillière, Tindall and Cox, 1929) to the water relationships in plants susceptible to virus diseases, but it is a frequent observation that plants so infected have, in general, poorly developed root systems

In order to understand these diseases more fully, much further work will be necessary on insect nutrition and metabolism, their habits, host-plants, and rates of reproduction, and in particular on the specific biological relationships which appear to exist in many cases between the insect and the disease it transmits In this connexion it seemed desirable again to direct attention to the water balance of plants as a factor in their resistance to insect pests

E PHILPOTT MUMFORD

Pacific Entomological Survey,
Marquesas Islands

D HOLROYDE HEY

The University,
Manchester, Feb 14

Starch Envelopes of Pyrenoids

THE pyrenoids are colourless masses of protein associated with the chromatophores in several classes of the Protophyta They have been most studied in the Isokontæ (Boubier, *Bull Herb Boissier*, **7**, p 451, 1899, Bourquin, *Bot Gaz*, **64**, 426, 1917), where they are embedded in the substance of the chloroplast and are covered with an envelope consisting of small starch grains which are the last to disappear under starvation conditions The pyrenoids are generally regarded as reserve protein stores During the formation of reproductive cells they disappear more or less completely

Starch formation and accumulation does not seem to be confined to the neighbourhood of the pyrenoids According to Timberlake (*Ann of Bot*, **15**, 624, 1901), however, in the case of *Hydrodictyon*, and to Carter (*ibid*, **33**, 475, 1919) in the case of *Cladophora*, all the starch is derived from the pyrenoids

If we regard the pyrenoids as storehouses of reserve protein, the exact conditions and the mechanism by which this reserve is utilised are not yet fully established Steinecke and Ziegenspeck (*Ber Deutsch Bot Ges*, **46**, 678 681, 24/1) are of the opinion that the pyrenoids function as a storehouse for a prophase of a starch building ferment, a view which has been adversely criticised by Czurda (*ibid*, **47**, 181 185, 25/4)

The observations of Timberlake and Carter indicate that a reaction as shown by the equation

Protein $\longrightarrow$ Carbohydrate + Protein Fission Product

is possible

The reaction might in fact be considered as reversible, thus, Protein $\rightleftharpoons$ Carbohydrate + Protein Fission Product

In a preliminary series of experiments on the action of ultra violet light on protein solutions, results have been obtained which may throw some light on this question of protein carbohydrate metabolism in plants A 0 50 per cent solution of recrystallised ovalbumin at any reaction increases in hydrogen ion concentration on irradiation In the case of ovalbumin, when the reaction is near that of the isoelectric point, the protein is partly or completely denatured Thus with an initial pH value of 5 92, four hours' irradiation partly denatured the protein and caused the reaction to drop to pH 5 33 The coagulum was soluble in alkali and not soluble in acid and was probably an acid metaprotein The most striking feature of the experiments was that formaldehyde was distinctly recognisable by its odour in several instances of prolonged irradiation

Irradiation in presence of chlorauric acid produced a splendid gold sol, but only if the solution was acidic in reaction The gold sol increased in depth of colour

when the solution was afterwards heated An irradiated solution of ovalbumin with a perceptible odour of formaldehyde gave on distillation an aqueous distillate neutral in reaction, and whilst not responding to the pyrogallol and nitroprusside phenylhydrazine tests for formaldehyde, it produced a brown coloration with ammoniacal silver nitrate on boiling

The conclusion is that formaldehyde (or some substance resembling formaldehyde) is produced on irradiation of ovalbumin by ultra violet light The increased acidity is probably due to conversion of amino groups to methylene derivatives by the aldehyde (Henriques and Sørensen, *Zeit physiol Chem*, 64, 120, 1909) An alkaline reaction evidently favours such a combination, with the result that no reducing action (as, for example, on gold chloride) can take place

That formaldehyde functions as a precursor of hexoses and starches is generally accepted, and hence it is conceivable that the protein of the pyrenoids can give rise to the carbohydrate of their envelopes

The action of ultra violet light on proteins is being further investigated

F O HOWITT

University College,
Nottingham, Feb 3

Globular Lightning

PROF MARCHANT's account of a case of globular lightning inside a room, in NATURE of Jan 25, leads me to think that the publication of the details of two somewhat similar instances which occurred in the dining room of the Faulhorn Hotel, near Grindelwald, are worth putting on record

I did not witness either occurrence myself, but I questioned Fraulein Suzanne Iacci, the manageress of the hotel, on the subject on Aug 2, 1925, her answers are given in inverted commas

It seems probable that both induction and stationary waves are concerned with the phenomena

"About 5 P M of a hot fine July afternoon in 1921, I was in the dining room of the hotel, with my sister Margaret and six other guests A dark cloud was noticed approaching from the east, but neither rain, hail, nor snow fell before the occurrence of the fire balls, and only distant lightning had been observed Suddenly from the air inlet of the large stove, in which a small wood fire was burning, came, practically simultaneously, a large number of very bright round balls of various colours, the largest perhaps nearly as large as my head Almost at the same moment, a dreadful deafening explosion occurred, and the balls had all vanished The room was full of a grey smoke —perhaps disturbed dust—and a strong peculiar odour was observed I opened the doors to clear the air, and then examined the room I could find no signs of scorching on the curtains, flowers, or the unenclosed stuffed birds and animals in the room The fire had not been disturbed, and none of the fuel was ejected The guests who were nearest the stove momentarily experienced a slight electric shock, but no one was injured I myself was farther away, and did not feel any shock

"In July 1914 my sister Louise and Madame Bohren, the wife of the proprietor, were in this same room during a hailstorm, and they had a similar experience On this occasion the stove was not alight No damage was done on this occasion either

"During thunderstorms I always warn people not to stand too close to the stove, as they sometimes receive nasty electric sparks There is no record of any serious injury here since the hotel was built in 1830"

I afterwards interviewed the sister (Margaret) and Mme Bohren in Grindelwald Their account nearly agreed with the above, though to the latter the incandescent spheres of 1914 appeared of the same colour and size—"reddish and of about the size of my two hands" I should add that this hotel stands in a very exposed position only a few feet from the summit of the Faulhorn (8800 feet) It is surrounded by a series of lightning conductors The closed cylindrical stove was 5 feet 4 inches high and 2 feet 2 inches diameter It stood just away from the wall of the room on a wooden plank The air inlet referred to above was rhomboidal in shape—the sides being 1 7 cm and 4 3 cm in length The iron flue at the top was 11 cm in diameter For warming purposes this flue passes horizontally through several bedrooms on the floor above the dining room before issuing through the roof some 20 feet above the stove I have a small photograph of this stove and will lend it to anyone interested in it

Since the last occurrence the stove has been 'earthed', and a lightning conductor has been fixed above the chimney

WILLIAM COLEBROOK REYNOLDS

"Wharfedale", Upminster,
Essex, Feb 4

Improvements in the Peel-Method of Preparing Sections of Fossil Plants

THE peel method of preparing sections of fossil plants was briefly described by me in NATURE of Oct 13, 1928, p 571 The use of cellulose esters was recommended for preparing peel sections Since writing that letter, I have performed experiments on the use of gelatine instead of cellulose esters, and have obtained results which fully justify the adoption of gelatine on many occasions in which this type of section is required For small sections the cellulose ester solutions are more easily applicable, but for large sections, for example, those exceeding 2 sq decimetres in area, gelatine is preferable

Gelatine peel sections are non inflammable and involve in their preparation none of the unpleasant smelling and sometimes actually noxious solvents necessary when using cellulose esters There is very little difference in translucency, cellulose pell sections are perhaps a little clearer than gelatine, but this advantage amounts to little

The surface of the petrifaction is prepared and etched with acid in the manner described before, washed, and then, *before* the surface is allowed to dry, a hot solution of jelly containing a certain quantity of glycerine and formalin is poured on to the surface The quantities and proportions used must be determined by experiment To cover a surface 1 sq decimetre in area it is necessary to use about 2 grams of fairly pure gelatine such as that used in making bacteriological cultures, 50 c c water, 0 5 c c glycerine, and 0 5 c c formalin (40 per cent) The surface must be surrounded before the etching process with a rim of plasticene or some other substance and should be levelled by means of a spirit level. The water and glycerine are mixed, heated, and the jelly stirred until dissolved The heating is continued until the mixture is at a temperature of about 60° to 80° C The formalin is then stirred in quickly and the solution is immediately poured over the surface of the petrifaction The jelly is allowed to set, and then the specimen under treatment may be removed with its adhering layer of jelly to a warm, well-aired place to dry Dust must not be allowed to settle on the jelly When the jelly has become dry it may be peeled off As it is always more brittle than cellulose

there is more difficulty in starting the peeling process, but on the other hand when once a satisfactory start is made it peels off more readily

Large sections have been prepared (about 20 sq decimetres in area) with scarcely a detectable flaw and with the cellular details of the fossil plants perfectly represented Gelatine peels may be cleared in zylol and mounted in Canada balsam solutions

John Walton

Botanical Department,
The University, Manchester, Feb 6

Matthew Island

On May 7, 1928, when on the s s *Suva*, I passed close to Matthew Island, in the South Pacific, but was unable to land It is about 200 miles from the nearest of the Loyalty Islands, and about 170 from the southernmost of the New Hebrides It is known to be inhabited by numerous sea birds, and it is possible to see green vegetation on the sides of the central mass I could not see any coconut palms From the heavy surf dashing against the shore, it appeared that landing would be difficult, but I was told that the island was used for target practice by British gunners during the War Owing to the position of the island, and the many interesting problems connected with the fauna and flora of the New Caledonia and New Hebrides groups, any endemic terrestrial animals or plants found upon it would be of extraordinary interest It may be that none will be found, but I think the chances for discovery are good enough to justify a careful search, especially in view of the richness of Norfolk Island and Lord Howe Island Perhaps there are some records, but I have not heard of any, and believe that no careful investigation has ever been made

Matthew Island was discovered in 1788 by Capt Gilbert on the *Charlotte* It is said to be 465 feet high, of volcanic formation, composed principally of basaltic rock The outline is roughly triangular, each side about a third of a mile long It may perhaps be regarded as the southernmost point of the New Hebridean chain, although the nearest relatively shallow water is that of the New Caledonian group

The Middleton Reef, north of Lord Howe Island, has a fair sized rock above the sea, but this is undoubtedly devoid of terrestrial life other than sea birds

T D A Cockerell

University of Colorado,
Boulder, Colorado, Feb 12

The Moment of the Bromine Nucleus

The following interpretation has been given by Kiess and de Bruin (U S Bureau of Standards *Journal*, in print) of the strong bromine arc lines

Int	λ	Combination
15	6631 64	$5s\ {}^4P_{5/2} - 5p\ {}^2D_{5/2}$
12	6559 81	$5s\ {}^4P_{5/2} - 5p\ {}^4S_{3/2}$
20	6350 74	$5s\ {}^4P_{5/2} - 5p\ {}^2P_{3/2}$
12	6148 62	$5s\ {}^4P_{5/2} - 5p\ {}^2D_{3/2}$

These lines have thus the same end-level ${}^4P_{5/2}$ originating in the coupling of a $5s$ electron

The hyper fine structure of bromine lines has been investigated by Kimura (*Mem Coll Sci*, *Kyoto*, **4**, p 133 1920) and by Hori (*Mem Coll Sci*, *Kyoto*, **9**, p 312, 1926) The above mentioned lines are quadruplets consisting of a series of components of decreasing spacing and intensities The distances between the components are in all cases practically the same $\Delta\nu = 0\ 19,\ 0\ 13,$ and $0\ 08$

In combining the value $i = 3/2$ with the value $j = 5/2$, one finds the right number of hyperfine structure levels, namely, four Further, one should expect on the basis of the interval rule for the ratio between the hyperfine structure levels 4 3 2, which is in good agreement with the observed values 4 2 7 1 7 It seems, therefore, probable that the moment of the bromine nucleus is $i = 3/2$

The Zeeman effect of these hyperfine structures will be investigated

T L de Bruin

Laboratory 'Physica' of the University
of Amsterdam, Feb 6

Zoological Nomenclature Acarine or Insect?

In answer to Dr C W Stiles's letter in Nature of Feb 9, 1929, p 207, in which he states "that application for suspension of the rules has been made in the case of *Nycteribia* Latreille, 1796, monotype *Pediculus vespertilionis* Linn, 1758 The Commission is requested to set aside the monotype designated in 1796 and to validate *Nycteribia pedicularia* 1805 as type of *Nycteribia*", I desire to point out that as Latreille's description is based on an insect, and as the so called monotype is an acarid, it follows that the name Nycteribia cannot supplant *Spinturnix* for the genus in which *Pediculus* [Scopoli used *Acarus* —Ed Nature] *vespertilionis* Scopoli 1763 is now placed

1 *Pediculus vespertilionis* Linné 1758 is a *Nycteribia* from his diagnosis, therefore no emendation is necessary

2 *N pedicularia* Latreille 1805 is the same species

3 *N vespertilionis* cannot be an acarid as suggested by the pretext for alteration

Anthony Musgrave
(Entomologist)

The Australian Museum,
Sydney, Dec 13, 1929

The foregoing letter from Dr Musgrave, one of the world's best known authors on the *Pupipara* (in which *Nycteribia* is classified), presents one angle of the triangular problem upon which the International Commission on Zoological Nomenclature has been requested to render an opinion (1) From 1763 to 1796, *Pediculus vespertilionis* Linn, 1758, was interpreted as an acarine on basis of Frisch's (1728) figure cited by Linnæus in 1758 (2) From 1796 to 1900 it was interpreted as an insect on basis of Latreille's description From 1900 to date it has been interpreted by some authors as an acarine, by others as an insect (3) If Linné's diagnosis be compared with the description by Frisch, the probability is seen to be present that Linné's *P vespertilionis* was a composite species consisting of an acarine plus an insect

In the communication printed in Nature of Feb 9, 1929, p 207, the Commission complied with the routine prescribed by the International Zoological Congress, that is when (as in this case) it may become necessary 'to suspend the rules' and to act under its 'Plenary Power', in order to settle certain cases of controversial nature, the Commission is required to give public notice of at least one year of its possible action, to enable every side to the controversy to submit its point of view

We are forwarding Dr Musgrave's argument to Mr Frederick Chapman, the Australian member of the International Commission, and to the Secretary of the Commission —Editor

Diving *

By Prof LEONARD HILL, F R S

THE new submarine escape dresses designed by Mr R H Davis have been successfully used at a depth of 130 ft at Loch Long and have since been adopted by the Admiralty Every man in the submarine service will have to have one, just as the soldier has his gas mask In case of accidental sinking of a submarine, each man will at once put on the dress and partly fill the breathing bag from the small oxygen cylinder which is fixed below the bag, and then breathe in and out of the bag through a cartridge of soda lime which is put inside to absorb the exhaled carbon dioxide Then the submarine will be flooded so as to equalise the air and the water pressure, and allow a hatch to be opened through which the men will float up one by one and reach the surface, the breathing bag, acting as a balloon, will take them there There is an escape valve provided for preventing over distension of the bag

In using the submarine escape dress, men must be trained to fill the bag only partially with oxygen, so as to allow expansion of the gas on coming up There is no risk of bubbles of nitrogen forming in the body fluids through coming up quickly, even from a depth of 300 feet, because oxygen has been breathed from the time the air pressure was increased by flooding the submarine

In case of prolonged difficulty in effecting escape from a submarine, surplus apparatus to afford fresh soda lime cartridges and oxygen will be required If the water has entered the submarine so that the air is under pressure, the bag should be filled with expired air two thirds full and only enough oxygen added to keep it comfortably full—this to prevent oxygen poisoning In this case, just before coming out, the bag must be squeezed empty and then filled with pure oxygen and this breathed for a few minutes so as to prevent bubbling off of nitrogen in the body

The new self contained diving dress allows a diver to get an air supply from a cylinder containing a mixture of air and oxygen, an injector device being used to draw the air in the helmet through a canister of soda lime The diver is free from hose pipe and air pump, and merely carries a life line with connexion for the telephone in his helmet Arrangement is made so that he can detach this line and leave it fast outside while proceeding into a wreck, using a distance line to find his way out by

The use of this apparatus is limited to a certain depth by the percentage of oxygen which it is safe to breathe If 50 per cent oxygen is supplied in the cylinder, the diver can safely do two or three hours' work in shallow water, but he should not exceed half an hour at a depth of 100 feet For greater depths, air with smaller percentages of oxygen must be used, and experience is required to work out the most suitable method of supply If the air is kept pure by absorption of carbon dioxide by means of a soda lime cartridge, then a small oxygen cylinder will suffice to keep the percentage in the helmet at, say, 10 per cent, for deep work The reducing valve can be set to give that amount of oxygen which the diver uses per minute, but there is a risk of too little oxygen arising through extra hard work on the part of the diver, and we must bear in mind that want of oxygen does not give warning before a man loses full use of his senses An additional cylinder of air with 10 per cent of oxygen in it will have to be carried for altering the buoyancy of the dress as needed Probably the ordinary method of ventilating the helmet by a hose pipe will be used for deep work a tank containing compressed air with 10 per cent oxygen being used as the supply A ready method of partially deoxygenating air will have to be installed on the diving ship

The new submersible decompression chamber, also designed by Mr R H Davis, was used with great success at trials conducted by the Admiralty at Loch Long last summer An attendant goes down in this cylindrical chamber, which is fitted with a door top and bottom, and waits to receive the diver at a depth of 66 feet The lower door is open and water kept out of the chamber by compressed air pumped into it The chamber is lit with an electric lamp The shot rope of the diver passes through rings attached to the outside of the chamber After doing his job on the bottom he ascends rapidly to the chamber, and climbing up by a small ladder thrusts his helmet up in the chamber, so far that the attendant can cast off hose pipe and life line and take off the helmet The diver then comes right in and the lower door is shut A telephone message is then sent and the chamber is raised to deck level and decompression carried out there From the time the diver leaves the bottom, all these operations take only seven or eight minutes to carry out, the diving ship can, if need be, then proceed to harbour This is a great improvement on the old method of the diver hanging on the shot rope in the cold and dark while decompression in stages is carried out Moreover, when in the chamber the diver can breathe oxygen by means of a small apparatus, and by this means shorten the decompression time by at least one half

There are three dangers from which the diver has to be protected First, he may be poisoned by too much carbon dioxide through insufficient ventilation If one air pump suffices to ventilate the helmet at one atmosphere, an extra pump is required for each atmosphere in addition, as pointed out by Dr J S Haldane, so at 300 feet ten pumps are required Many divers have been made less efficient while at work and damaged in health by insufficient ventilation In place of so many pumps, a canister of soda lime can be arranged to purify the air in the helmet, and this is an improve-

* From the Friday evening address delivered at the Royal Institution on Feb 7

ment which will, I think, be adopted for deep diving Secondly, at considerable depths the diver is exposed to high tensions of oxygen, for example, at 300 feet, to 10 atmospheres of air, which is equivalent to 2 atmospheres of oxygen, and oxygen at any tension a little greater than 70 per cent of an atmosphere acts as a poison when breathed for more than a certain time, the time becoming shorter as the tension is raised While exposure for some days to a tension of oxygen greater than 70 per cent of an atmosphere produces pneumonia, experience has shown that the breathing of pure oxygen at a pressure of one atmosphere for a few hours, as in the use of mine rescue apparatus, has no ill-effect

Experiments have shown that animals can safely breathe 2 atmospheres of oxygen for 2 hours, but during this period both the use of oxygen by the body and the output of carbonic acid diminish, the body temperature drops and the animals become drowsy If the exposure is more prolonged, or in shorter times if the oxygen tension is higher, the animals fall into a comatose condition and finally have convulsions and die Some very important experiments were made by Bornstein at the Elbe tunnel works He breathed oxygen at 3 atmospheres (+30 lb) for 48 minutes, and two of the engineers (at the Elbe tunnels) for 30 minutes without harm He considered periods such as these set the limits to safety

In diving experiments in the United States of America in connexion with the practice of an American submarine escape apparatus, oxygen has been used without detriment for short periods up to a pressure of about twelve atmospheres, equivalent to 357 feet of water

Argyll Campbell has shown that normally when breathing air the tension of oxygen in the tissues equals 37 mm of mercury The blood in the veins coming from the tissues is normally about 75 per cent saturated with oxygen and carries 2½ to 3 volumes per cent more carbon dioxide than the arterial blood, which is 95 per cent saturated with oxygen Under high oxygen tensions in the inspired air, the tissue oxygen tensions rise, for example, from 84 mm to 430 mm of mercury, and the venous blood, being almost fully saturated with oxygen, can carry very little more carbon dioxide than arterial blood Moreover, when the tissues are in danger of oxygen poisoning, the circulation may be reduced Thus carbon dioxide is held back in the tissues and the tension may rise to poisonous heights, as was found to be the case by Argyll Campbell

It is clear, then, that for deep diving the ventilation of the helmet must be kept adequate enough to prevent even a small rise of carbon dioxide in the air breathed It must be kept in mind that, at 10 atmospheres, 0 1 per cent of carbon dioxide in the air breathed produces a tension of carbon dioxide of 1 per cent of an atmosphere, and 1 per cent produces a tension of 10 per cent The poisonous effect depends on the tension, and 10 per cent is enough to anæsthetise a man If there is difficulty in carbon dioxide being carried from the tissues owing to high oxygen tension, this difficulty must not be accentuated in the least degree by ill-ventilation of the helmet, otherwise the diver may become drowsy, and even comatose

To avoid any poisonous effect of oxygen for deep dives the percentage in the air supplied to the helmet can be halved Mr R H Davis has contrived apparatus for effecting this, that is, for supplying less oxygen during compression, and more during decompression, for diving to greater depths, air with still less oxygen in it will have to be used As pure oxygen is going to be used in the submersible decompression chamber, it is obviously best to prevent any excess of oxygen while at work on the bottom At 10 atmospheres, 2 per cent of oxygen in the air would give a diver the natural amount of oxygen Suppose, for safety sake, that 10 per cent of oxygen is used at 10 atmospheres, the nitrogen will be increased by one atmosphere, and this will have to be allowed for in reckoning the decompression period

The effect of breathing oxygen in washing out nitrogen can be shown If diuresis is established by drinking two or three pints of water, the secretion of the kidneys can be used as a measure of the nitrogen dissolved in the blood The bladder can be emptied every few minutes and samples of the urine collected with precaution to exclude contact with air The dissolved gas can be extracted by a vacuum pump, and the amount of nitrogen estimated At ordinary atmospheric pressure, there is approximately 1 per cent of dissolved nitrogen gas, at 2 atmospheres 2 per cent, at 3 atmospheres 3 per cent, and so on The effect of breathing oxygen for nine minutes during exposure of the body to a pressure of 3 atmospheres (+ 30 lb) was to lower the percentage of nitrogen in the urine then secreted to 2 1, and in the next six minutes to 0 9 Urine secreted during decompression after being at + 30 lb pressure, this time with no breathing of oxygen, contained 2 86 per cent of dissolved nitrogen, more than three times as much It is clear, then, that the breathing of oxygen quickly washes out nitrogen dissolved in the blood and tissues of the kidneys

The washing out of nitrogen from the body by breathing oxygen has been shown in another way, by Argyll Campbell and myself After taking three or four deep inspirations from a bag full of oxygen and expiring into the air so as to wash most of the nitrogen out of the lungs, a deep expiration is made and a sample of alveolar air collected, the subject then breathing through a soda-lime cartridge in and out of a spirometer containing a few litres of pure oxygen A sample is drawn from the spirometer for analysis at 3 min and 6 min, in each case at the end of a deep expiration, and the volume of gas in the spirometer being on each occasion measured At the end of the deep expiration a sample of alveolar air is also collected from the tube leading to the spirometer The volume of the residual air in the lungs can be calculated, and so, too, the use of oxygen in metabolism by the subject during the period

It is estimated that there are about 960 c c of

nitrogen dissolved in the body of a man under ordinary atmospheric pressure, say 30 c c in the blood, 510 c c in the fat, which dissolves about five times as much water, and 420 c c in the other tissues Our experiments show that about 30 c c of nitrogen per minute are washed out in the first few minutes from a man at rest, and about 50 c c from one doing stepping exercise It seems clear, then, that by breathing oxygen, and exercise, the washing out of half of the nitrogen, probably that amount which causes bubbling and severe symptoms on decompression, takes place in about 10 minutes It is safe for a diver to breathe oxygen during the time required for decompression in the submersible chamber from 3 atmospheres absolute pressure (66 feet approx depth) if the oxygen breathing allows the times of the Admiralty table set for the safe decompression of divers to be halved

Further research on animals is now being carried out to settle the point whether the formation of bubbles can be prevented by plus two atmospheres of pressure (66 ft depth) when a diver is quickly decompressed from 300 ft to that pressure after a prolonged stay on the bottom Possibly a stage will have to be given at 99 ft If the diver is supplied with, say, 5 per cent of oxygen at the great depths, he can safely begin to increase the oxygen in his helmet as he climbs up from the bottom, using a small cylinder of pure oxygen for this purpose, and then arriving at the submersible decompression chamber be ready to breathe pure oxygen at plus two atmospheres and during the decompression from that pressure When a bottle of champagne is opened in a chamber at plus two atmospheres, it appears flat, as this pressure stops the formation of bubbles and the gas escapes quietly In the trials at Loch Long, divers came up quickly from 300 ft to 66 ft and suffered no harm It is important that the deep sea divers go down fasting with the least gas in his alimentary canal Gas formed therein mechanically obstructs the circulation by expanding during decompression and enhances the danger of bubbles forming in the blood Out of twenty-four well-fed guinea pigs compressed for 1 hour to plus 100 lb and decompressed in five minutes, nineteen died, out of twenty-four fasting guinea pigs only eleven died None died when oxygen was given during the period of decompression

The U S Navy is experimenting with helium and oxygen, helium has less solubility and greater diffusivity than nitrogen, and good results are reported We have no available helium

There are certain other dangers to which the diver is exposed, as were evidenced by the salving of the *S 51* submarine by the U S Navy The inlet valve may become blocked by ice due to freezing of water condensed out of the air pumped down the hose pipe in wintry weather when the salt water at the bottom of the sea is below freezing point One diver was drawn up just in time, half suffocated, another was far inside the submarine when this happened, but managed to knock his valve free of ice by striking the outside with a spanner The air-supply after that had to be freed from water vapour for such wintry diving It is astonishing that the divers can work with their hands exposed to such cold water even when gloved A thick, knitted wool glove containing air in its meshes with a rubber glove outside is, of course, the best protection against cold

Another danger is the outlet valve becoming jammed through sand getting into it when lying down and tunnelling as those American divers did through clay, using a fire hose and high pressure water to cut out the clay If the outlet valve closes, a diver may have his dress blown out and be spread eagled before he can shut off his air supply or open his spit cock and use that as an air outlet If his telephonic message to cut off the air be not heard his dress will be burst This actually happened to Eddy, a famous diver, but another diver witnessed the accident and, telephoning the news, Eddy was drawn up in time, put in the recompression chamber, and saved To be blown up is dangerous, first, because of the rapid decompression, and secondly because of the risk of the helmet hitting the bottom of the attendant ship If a diver be blown up to the surface, he must be at once sent down again after letting out excess of air, or have his helmet taken off and be rushed into the recompression chamber

The courage and presence of mind of divers is shown by the story of a diver named Smith who, when tunnelling out the clay and getting near the keel of the submarine *S 51*, had the clay walls of the tunnel fall in upon him He telephoned for help, but managed to turn round the nozzle between his legs and force out the clay and so escape, then, telephoning he was all right, he went back again into the tunnel and completed the job, and this down in the dark at a depth of 130 feet

The oxyhydrogen flame has been adapted for use under water, and large thicknesses of metal were quickly burnt through by this means in the salving of *S 51*, by Commander Ellsburgh

The 'iron man' designed in Germany and used in wrecks by Italian divers is an observation chamber with jointed limbs which allow a certain amount of awkward movement The joints have ball bearings The diver, shut inside, is at ordinary atmospheric pressure and breathes oxygen, having the exhaled carbon dioxide absorbed by soda lime He can use the oxygen supply also to alter the buoyancy of the iron man There are glass discs for observation, and in dark water a powerful electric lamp has to be lowered down for him to see by At a depth of 100 feet the sunlight appears as moonlight, and at 200 feet as starlight Tools are affixed to the end of the 'iron man's' arm, and the diver works these by scissor like handles inside The diver in the 'iron man' cannot use his sense of touch, and prolonged training and good lighting are necessary for effecting any skilled work After a dozen trials in it, one diver failed to shackle a rope on to a buoy The diver in the 'iron man' can guide a charge of guncotton, or a grab for seizing hold of wreckage, but is not capable of very skilled work

Mineralogy at Cambridge

THE report of a syndicate appointed by the Council of the Senate of the University of Cambridge to consider the position of mineralogy in the studies of the University was the subject of a lengthy discussion in the Senate House on Jan 28 The recommendations contained in this report were summarised in a leading article in NATURE of July 13, 1929 They have since been reported on by the University Boards concerned and by the Committee of the Natural Sciences Tripos

The proposals for the creation of two departments —one of mineralogy and petrology, and one of crystallography—met with approval in principle, but the Financial Board had already indicated that no money was forthcoming to meet the additional expenditure involved except "at the expense of existing University activities" No definite opinion is expressed on the proposal to make 'half subjects' in the examination of crystallography and of mineralogy and petrology, as this involves problems of some difficulty It is, however, suggested that the regulations for the Natural Sciences Tripos should receive general reconsideration

The Syndicate included distinguished representatives of every science bordering on mineralogy, and it was perhaps natural that its report (which was unanimous) should have dealt mainly with the relations of mineralogy to other sciences The discussion, however, was left entirely to mineralogists and geologists, among whom the report has aroused very considerable interest and some controversy That this interest is not confined to resident members of the University is indicated by the fact that speakers in the discussion included two professors of geology in London, the professor of geology in Edinburgh, and four of the curators of the two great collections of minerals and rocks in London (the Natural History Museum and the Museum of Practical Geology) The resident members of the University participating in the discussion (which occupies twelve pages in the *Cambridge University Reporter*, Feb 11) were the professors of geology and mineralogy, the chairman and secretary of the Syndicate, the reader and the lecturer in petrology, the lecturer in structural crystallography, and two other members of the staff of the Department of Mineralogy

The speeches of the professor of mineralogy and of the lecturers in petrology and in structural crystallography outlined the possible scope and the present difficulties affecting teaching and research in their subjects

The lecturer in structural crystallography spoke whole heartedly in favour of a separate Department of Crystallography, and with this recommendation of the Syndicate the other speakers (with two exceptions) seemed disposed to agree The professor of mineralogy regretted that the Syndicate had not considered the possibility of housing crystallography, mineralogy, and petrology under one roof, and quoted the examples of Zurich and Göttingen Mr Hallimond felt that any Department of Mineralogy had a reason for having an X-ray department on the crystallographic side, while many parts of the X ray researches, involving some of the most advanced theories of modern physics, really belonged to that Department Additional point was given to this suggestion by the remarks of the lecturer in structural crystallography, who seemed to envisage a department for the X ray study of the solid state, and foretold a remodelled teaching of crystallography which evidently gave some of the mineralogists seriously to doubt whether "the teaching of such crystallography and crystal physics as is required by students of mineralogy and petrology" would be provided by the new department Another speaker made it clear, however, that the need in X ray research of a sound knowledge of geometrical 'surface' crystallography was fully realised

On the recommendation to bring mineralogy and petrology into one department and to house them in a new building adjacent to the Sedgwick Museum, the speakers were almost all in agreement, The only important difference of opinion revealed is on the extent to which the study of advanced petrology should be restricted to students of geology, and whether the association of the newly constituted department should be quite so close as that provided for in the recommendations for the reorganisation of the Tripos

Non residents with experience in other universities spoke highly of the teaching of both mineralogy and petrology in Cambridge, and emphasised the need for maintaining its schools in these subjects in the pre eminent positions which they have occupied in the past On the other hand, it is evident that many speakers considered that the progress of both studies was seriously hampered, if not actually stopped, for want of adequate accommodation and facilities for research along modern lines Particular stress was laid on the urgent need for a laboratory for research in experimental petrology on the lines so successfully followed at the Geophysical Laboratory of the Carnegie Institution of Washington

The lecturer in petrology made a good point when he remarked that research and Part II work in mineralogy was spasmodic, and therefore unsatisfactory, because of the few openings available for men trained in mineralogy alone The union with petrology (and geology) would, he thought, induce a steady flow of students to take up Part II work and research in the two subjects Prof Watts spoke strongly in the same sense of the extensive increase in the possibility of research which would be offered by the united departments He also reminded his hearers that a proposal to establish a laboratory in Cambridge on the lines of that of the Carnegie Institution of Washington had been before the Conjoint Board of Scientific Societies several years ago and had been abandoned only because of expense

Following publication of the report of this discussion, notice was given of a Grace approving in principle the policy of dividing mineralogy and petrology for the purposes of teaching and research into crystallography on one hand and mineralogy and petrology on the other The Grace was passed unopposed on Mar 8 This is the first part of the Syndicate's report which received almost unanimous support in the discussion the second was the desirability of housing mineralogy and petrology in a new building, thus making room for crystallography in the old It is to be hoped that the means will speedily be found to build and equip the new laboratories and thus to make possible in Cambridge the kind of teaching and research on the need for which there seems such unanimity of opinion among competent judges It may be remarked that every branch of research mentioned in the discussion, both in X ray work on crystal structure, and in the study of ores, of rocks, and of silicate melts, has its direct application in industry

Obituary.

PROF F M EXNER

FELIX M EXNER, professor of geophysics in the University of Vienna, director of the Zentral anstalt fur Meteorologie und Geodynamik, Vienna, and joint editor with Suring of the *Meteorologische Zeitschrift*, died in Vienna on Feb 7 Exner, who was a son of the physiologist Sigmund Exner, was born in Vienna on Aug 23, 1876 He was educated at the University of Vienna, where he graduated as Ph D in 1900 After ten years as assistant at the Zentralanstalt, he became professor of cosmical physics at the University of Innsbruck in 1910, returning to Vienna in 1917 to take up the post of director of the Zentralanstalt and professor of geophysics

Exner was a very active research worker in meteorology and allied sciences, and published a large number of papers in the proceedings of the Vienna Academy of Sciences, the *Meteorologische Zeitschrift*, the *Annalen der Hydrographie*, and various other journals These papers cover a wide field He was particularly interested in the mechanism of changes of pressure, and in the earlier years, in the correlation between meteorological factors over different regions of the globe He treated the latter question at great length in a paper in the proceedings of the Vienna Academy of Sciences, vol 122, the work having been largely carried out during a visit to the United States

Exner was an industrious and sound, rather than a brilliant worker, and he will be remembered for his treatise " Dynamische Meteorologie ", rather than for his original work This book, which gives a very clear exposition of the outlook of the Austrian school of meteorologists, stands alone to day as the only available exposition of the mathematical aspects of meteorology Its preparation, which must have involved years of unremitting labour, was doubtless facilitated by his appointment to the professorship of cosmical physics at Innsbruck The Austrians are fortunate in having this professorship, to which they can appoint a young man to enable him to carry on research work or authorship unimpeded by official duties, and this professorship has usually been the avenue of approach to the post of director of their meteorological service

There is no text book in the English language which is strictly comparable with Exner's The dynamical methods followed by Exner, Margules, and others of the Austrian school of meteorologists have not been very widely used in England or the United States, and as a result, English text books are either descriptive or physical, rather than mathematical Thus Exner's book has met a widely felt need among meteorologists, and is one of the few books of which we can say with complete honesty that it is indispensable to any serious student

Exner was also the author of an article on dynamical meteorology in the " Enzyklopadie der mathematischen Wissenschaften", but a more out standing service to science was the publication in 1922 of a revision of Pernter's classic text book on meteorological optics He also prepared the European portion of " World's Weather Records ", published by the Smithsonian Institution

As director of the Austrian meteorological service, Exner was a member of the International Meteorological Conference His pleasing personality won him the respect and liking of his international colleagues, and his death will be regretted by meteorologists throughout the world D B

DR G G CHISHOLM

GEORGE GOUDIE CHISHOLM, who was the first lecturer (1908) and later the first reader (1921) in geography at the University of Edinburgh, and acted also as secretary of the Royal Scottish Geographical Society from 1910 to 1925, died very suddenly in Edinburgh on Feb 9 Born on May 1, 1850, he was thus on the eve of completing his eightieth year, though few of his associates realised the fact, his mental vigour being unimpaired to the end, while even physically there were few signs of age

A native of Edinburgh, Dr Chisholm attended the Royal High School there and took the degrees of M A and B Sc at the University, which after his retirement in 1923 bestowed upon him the LL D He spent his earlier life in Scotland, going to London in 1895 There, until the date of his Edinburgh appointment, he was engaged in lecturing and literary work, and soon became a prominent figure at the annual meetings of the British Association, being president of Section E (Geography) in 1907 Of his writings, those through which his influence was most felt were his " Handbook of Commercial Geography ", first published in 1889, of which an eleventh edition appeared in 1928,

and "Longmans' Gazetteer of the World", of which he was editor, which first appeared in 1895 and has been often reissued Both works show that rigorous accuracy in detail, based upon pro found and wide research into original sources, and that sober and balanced judgment which were his outstanding characteristics

Dr Chisholm may, indeed, be said to have been one of the founders of scientific geography, particularly from the economic side, within Great Britain Not only did he show that it demanded as exact scholarship, as wide knowledge as the subjects which had been recognised earlier as worthy of academic rank, but also at a time when, with the apparently sudden recognition of its interest and wide ramifications there was grave risk of hasty generalisation, he insisted upon the need for precise and, if possible, statistical proof of fundamentals Rigidly conscientious himself, and with a passion for accuracy and completeness of statement, he was peculiarly impatient of slovenliness, whether in speech or thought, and if modern geography in Great Britain may seem to have developed relatively slowly, it is to Dr Chisholm largely that we owe the fact that its foundations have been well and truly laid

Dr Chisholm's influence also extended far beyond the limits of his own country His "Handbook of Commercial Geography" had the rare distinction of being translated into Arabic, and he carried on an extensive correspondence with geographers, economists, and others throughout large parts of the world It was characteristic that his handwriting was clear and precise to the end and that he would give to letters, even on trifling matters, the same care and attention as to his own special work His help and advice were, in consequence, constantly asked for, and so freely given as to bring him into contact with a wide circle Though never in much sympathy with the narrowly nationalist Scottish point of view, he was a Scot of the best type, upright, honourable to the last degree, fair minded, indifferent to worldly advancement, but profoundly concerned with the deeper problems of man's destiny, and too clear-sighted to be content with easy solutions Even apart from his influence on economic geography and history, which was both wide and deep, the example he set of a life devoted to the search after knowledge was an inspiration to all who knew him

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We regret to announce the following deaths

The Hon Edward Gerald Strutt, C H, past president of the Surveyors' Institution and agricultural adviser to the Board of Agriculture during the War, on Mar 8, aged seventy five years

Prof Eugenio Rignano, professor of theoretical philosophy at the University of Milan and editor of *Scientia*, on Feb 9

News and Views

Sincere regret will be felt throughout the world of science at the destruction by fire of a large part of Lord Rayleigh's laboratory at Terling Place, Chelmsford, Essex, on Mar 7 After taking his degree at Cambridge in 1865, the late Lord Rayleigh found great difficulties in getting opportunities for experimental research or instruction in laboratory work Three years later he started experiments on his own account at Terling Place, and from there produced a number of papers which at once secured for him a position as a leader in physical science When he resigned from the chair of experimental physics at Cambridge in 1884, he continued his researches in his private laboratory, and it was there that he carried out the precise determinations of the density of nitrogen which led to the discovery of argon The simplicity of the apparatus used by the late Lord Rayleigh is well known, and most visitors to the laboratory were astonished that results of prime significance could be obtained with such modest equipments We are glad to know that most of this historic apparatus has been saved as well as all books and papers belonging to the late Lord Rayleigh

The upper storey of the laboratory at Terling Place—originally a stall loft—has been burnt out, it was here that the main work on argon was done Among the pieces of historic apparatus which have been destroyed are the original Rayleigh refractometer and the manometer used for adjusting the pressures of gases to an accurate standard in the weighings of nitrogen, hydrogen, and oxygen Most of the present Lord Rayleigh's chief working instruments have also been destroyed and much preparatory work for experiments in progress is gone The apparatus thus lost includes several valuable spectrographs, quartz apparatus and lenses for investigating the optical properties of mercury vapour, air pumps, equipment for measuring the light of the night sky by photo electric cells, and other instruments used in recent or current researches It is distressing to have to record a disaster of this kind, and we ask Lord Rayleigh to accept the sincere sympathy of scientific workers everywhere at the losses he has suffered and the consequent interference with his research work

The Department of Scientific and Industrial Research has, since the inception of research associations, always emphasised that the associations, to be eligible for grant from the Department, must secure adequate financial contributions from industry itself While the securing of this support from the great industries has not been an easy matter, it is gratifying to find that in several of the most important industries of Great Britain a general levy is made in order to provide funds for particular research associations The report of the council of the British Research Association for the Woollen and Worsted Industries for 1929–1930 indicates that this Association is about to complete an arrangement under which the wool textile industry will submit to a voluntary levy on imported wool, mohair, and so on, as well as to a levy on those processing sections of the industry which do not pay the levy on the raw material The income which will

thus become available, together with the generous assistance which is being given by the Empire Marketing Board, the Ministry of Agriculture, and by the Dominions of South Africa, Australia, and New Zealand, should ensure that the future work of this important Research Association shall be conducted on a scale which the importance of the industry to the Empire as a whole properly demands

The British Research Association for the Woollen and Worsted Industries has continued to devote its attention to fundamental problems of research into the properties of individual hairs and fibres, as well as to technical and more practical problems of the trade itself The determination of Young's modulus for the wool fibre appears to indicate that plastic flow occurs in the fibre after the initial rapid change of length due to change of load If the measurements are made quickly, the extension of fibre appears to be proportional to the load over small ranges of change of load, and it exhibits negligible hysteresis The examination of the cultivation of skin and hair by tissue culture methods, and of the effect of diet on the characteristics of the fleeces, is being continued The result of the examination of samples of wool for mean fineness has indicated the extraordinary variability which occurs over very small areas This condition constitutes, of course, an important problem for the wool sorter, and, as such, is of sufficient practical importance to justify the most exhaustive experimental examination An important practical application from the chemical work of the Association may arise as the result of an investigation which appears to indicate that low quality and waste woollen materials may be dissolved and spun in the manner which has now become familiar in the production of artificial silk yarns Yarn has already been produced from a mixture of wool and cellulose, and solvents have been found which may make possible the production of a similar all wool yarn

From time to time references have been made in Nature and elsewhere to the need for authoritative portrayal and dissemination of the scientific point of view It is, of course, neither useful nor possible that everyone should be trained to elucidate scientific facts or substantially to understand the implications of properties and behaviour, nor even is it reasonable that he should with much labour and exclusion of other important affairs acquire that foundation of special knowledge which would enable him to do so On the other hand, it is clearly desirable to show the general public that science does not depend for its advance on the intuition and 'formulæ' of a few 'brilliant inventors' so much as on ordered, if sometimes laborious, experiment and deduction It needs to be constantly advertised that chemistry, for example, progresses because chemists make use of strategy and tactics which they have been able to develop by applying scientific methods of thought and by consistently employing the results of scientific inquiry

If the problems of chemistry can be solved thus, so also, by similar appropriate methods, can those of other factors in the life of the individual or his community In a recent issue of *The Listener*, Prof Arthur Smithells made a noteworthy contribution to the education of the general public in this particular Confining himself to simple, fundamental facts and to the study of their relationships, he succeeded in exposing in a pleasant, conversational manner something of the working of the experimenter's mind and something of the way in which our knowledge concerning combustion was acquired The B B C is wise to include in its publication devoted to raising the general standard of culture such an article as that contributed by Prof Smithells Whether the B B C can assist would be students of chemistry in their actual studies is, of course, entirely another matter When telephony and television are joined by radio olfaction, who knows what it may not be possible to broadcast?

At the annual general meeting of the Institute of Chemistry, Prof Arthur Smithells, the president, in moving the adoption of the report of council, made some observations on the question of chemical training, urging in particular that the burden now put upon the student is excessive and too apt to result in undigested knowledge of what are regarded as the higher things of chemistry, with accompanying neglect of what is more simple and basic He thinks that the courses have become congested and the pace too rapid, though he acknowledges the great improvement that has taken place in schools of chemistry in Great Britain It is now no longer necessary to go abroad for the latest or the best in any division of the science we are, in a way, doing too much rather than too little He alluded at some length to the ways of teaching and work which prevailed in Bunsen's laboratory at Heidelberg as illustrating the kind of conditions under which, he believed, the early training of the chemist might be more satisfactorily conducted Prof Smithells said he had only touched on one part of a very large question and was concerned to arouse interest in it rather than to lay down any law, the education of the professional chemist is really an important question of the day and calls for the most careful consideration The report of council shows that the roll of the Institute has increased by 156 members and 20 students, that the Institute is in a sound position financially, and that the committees of the council and local sections have been actively engaged in the interests of the profession of chemistry The Meldola Medal was awarded to Dr R A Morton, of Liverpool, and the Sir Edward Frankland Medal and Prize to Mr B W Bradford The officers and members of Council for the ensuing year were elected, Dr G C Clayton being elected president in succession to Prof Smithells, who has occupied the chair during the past three years

As a result of heavy and long continued rains at the end of February and the beginning of March, disastrous floods have occurred in southern France, entailing enormous damage to property and the loss of several hundred lives The floods reached their greatest intensity in the valley of the Garonne and

its tributaries, especially the Tarn, which originate in the southern Auvergne Mountains Few details are yet available, but it appears from the *Bulletin Quotidien d'Études*, published by the French Meteorological Service, that the heavy rain was associated with a persistent strong south easterly wind blowing from the Mediterranean Even on the low ground of the coast and of the Rhone valley, falls of two or three inches in a day were reported from several stations on Feb 28 and Mar 1, and where the moist wind struck the higher ground one would expect the rain to be very much heavier The rivers flowing westward from the Auvergne Mountains occupy deep narrow valleys which offer no opportunity for the floods to dissipate, and the water appears to have risen with such rapidity that the inhabitants of the valley towns were caught almost unawares Where the swollen streams debouched on the low ground of the main Garonne valley conditions were even worse, and the greatest disaster of the week occurred at Moissac, near the junction of the Tarn and Garonne The report says that the Tarn burst its banks, and the town was almost entirely destroyed

IN his Huxley lecture to the University of Birmingham, delivered on Mar 6, Sir William B Hardy dealt with "The Physical Basis of Life", which was the subject of one of Huxley's essays in 1868 He asked if we could still be as sure of the soundness of Dujardin's postulate of the one common physical basis of life, protoplasm, as Huxley was? And are we right in ascribing to this protoplasm the contradictory attributes of extreme stability and extreme instability? The view to day is that protoplasm *is* the physical basis of life, but there are as many distinct varieties as there are species of living organisms, the differences in the chemistry of their proteins giving rise to such varied forms as a whale or a gnat, a mushroom or a man All forms of organisms from the whale to the smallest bacillus are built up on this fundamental basis, but the gap between the smallest bacillus and the properties of the half dozen kinds of atoms of which it is made is immense This gap has perhaps been partly bridged by the discovery of the viruses The virus is only known by its effects, it is exceedingly potent in producing disease and yet is so small that it passes through the pores of unglazed porcelain, its dimensions may be compared with those of a sphere of 0 000025 mm diameter It possesses great power of multiplication A small drop of fluid from a dog with distemper may be diluted ten million times, and yet when a drop of this is injected into another dog, the virus may multiply to such an extent that in three days it has invaded every tissue, and if the rest of the dog could be removed, leaving the virus, the latter would form a good model of the dog These viruses possess individuality and are not interchangeable Are they to be regarded as protoplasm? We can scarcely regard so small an aggregation of molecules, 400 or 500 say, as the basis of life Perhaps they are 'first attempts' at protoplasm, parasitic on more advanced forms

IN his Friday evening discourse, delivered at the Royal Institution on Mar 7, Dr C Tate Regan spoke on "Angler Fishes" In off shoots of the perch tribe the spinous dorsal fin is variously modified, in the angler fishes its spines have become slender and flexible, and the first is placed on the head, and serves as a line and bait Anglers that lie on the bottom have a coloration that harmonises with their surroundings and tends to conceal them, their bait or lure is a flap or a tassel at the end of the line, and is used to entice other fishes near enough to be caught The anglers that float about in the middle depths of the ocean, where there is little or no light, are uniform in colour, generally blackish, and possess a luminous lure Oceanic anglers generally have a large mouth, strong sharp teeth, and a very distensible stomach, such fishes are able to swallow others many times their own size An interesting group of these oceanic anglers includes little fishes that have lost the line and lure, live at lesser depths and seek small prey by smell and sight, they have a small mouth and feeble teeth, but large nostrils and olfactory organs, one has the eyes directed forwards, and the snout is shortened in relation to stereoscopic vision All the free swimming oceanic anglers are females, and the only males known are dwarfs parasitic on the females, to which they are completely united The males, as soon as they are hatched, when they are relatively numerous, seek the females, if they find one they hold on by the mouth, then the lips and tongue unite with the skin of the female, and the husband becomes an insignificant appendage of his wife, degenerate in structure, and nourished by the continuity of his blood system with hers The evolution of the dwarfed and parasite males is difficult to explain unless it be assumed that the actions and reactions of the fishes themselves produce modifications that become hereditary

ON Mar 6 a public lecture on 'Twenty five Years Study of the Polar Aurora" was delivered at Oxford by Prof C Størmer of Oslo A large series of photographs, taken during the last twenty years, was exhibited Base lines starting from Oslo and going in several directions were employed for taking these photographs, and by means of the parallax thus shown, the height of the lower border of each aurora had been calculated This was found to be usually in the neighbourhood of 100 km above the surface of the earth, though in some instances a height of 600 800 km. was reached The height was greater in the morning and evening than at night Many of the phenomena could be explained, said Prof Størmer, by attacking the problem in a simplified form, such factors as gravitation, repulsion, etc., being omitted He attributed the aurora to a stream of negative electric corpuscles passing from the sun through the magnetic field surrounding the earth's magnetic axis This view was illustrated by a number of photographs of ingenious models In moving a vote of thanks to Prof. Størmer, Prof Lindemann observed that he hoped that the omitted factors would eventually be taken into account He thought that Prof Størmer's explanation of the 'echo' phenomenon was perhaps the most interesting feature of the whole research

SWITZERLAND is to have a 'regional' broadcasting system, somewhat similar to that which is being instituted by the British Broadcasting Corporation, with three high power stations—in the German, French, and Italian speaking sections of the country respectively—and smaller relay stations where required in the principal towns The most powerful of the new stations, a Marconi Type 'P B' 60 kilowatt broadcasting transmitter, is to be erected at Munster, about twelve miles to the north west of Lucerne, and will constitute the main 'regional' station for German speaking Switzerland It will be allotted the wave length of 459 metres To provide for 'crystal listeners' in the towns, Marconi broadcasting stations of ½ kilowatt aerial power are to be erected at Berne and Basle The new station at Berne will replace the present Marconi 1 kw 'Q' broadcasting station, which was erected in 1925 and will later be modernised and re erected elsewhere to play a part in the 'regional' plan At Basle the new station will be this town's first full time broadcasting station, the broadcasting service having previously been carried out by the Marconi transmitter at the Basle aerodrome, which is primarily employed for wireless telephony with air craft The reorganisation of the Swiss broadcasting service on the 'regional' basis is expected to be completed in 1931

IN connexion with the Physical and Chemical Survey of the National Coal Resources, which is one of the important aspects of the Fuel Research work of the Department of Scientific and Industrial Research, the Department has recently appointed a committee to deal with the West Yorkshire Coal Area Among the members are Prof J W Cobb, Leeds, Prof J A S Ritson, Leeds, Mr C E N Bromehead, Geological Survey of Great Britain, Dr C H Lander, Director of Fuel Research, and Dr F S Sinnatt, Superintendent of the Coal Survey The object of the Survey is to investigate the characteristics of the various coal seams in Great Britain with the view of their utilisation to the best advantage Local laboratories are established in each area for the examination of samples, and, when necessary, large scale investigations are carried out at the Fuel Research Station (East Greenwich) or elsewhere The Survey is now in active operation in most of the coalfields of Great Britain

THE recent award of the Roozeboom gold medal to Prof J J van Laar was made at a special meeting of the Royal Academy of Sciences at Amsterdam by Prof Schreinemakers This is the third time since Roozeboom's early death in 1907 that such an award has been made, the other recipients being Profs Schreinemakers and Tamman From the *Chemiker Zeitung* we learn the following particulars of van Laar's career, as outlined by Prof Schreinemakers Born in 1860 at The Hague, van Laar first adopted the career of a naval officer, and in that capacity he travelled over the whole world In 1881 he began to study at the University of Amsterdam, where he came directly under the inspiring influence of van 't Hoff and van der Waals In 1898 he was appointed lecturer in mathematical physics and chemistry, and in 1907 he was appointed successor to Prof Bakhuis Roozeboom, but he resigned his chair five years later for reasons of health From 1892 onwards there appeared under his name a constant stream of scientific papers, amounting to more than two hundred and covering almost every branch of physical chemistry

PROF VAN LAAR devoted much attention to the melting point and freezing point curves and vapour pressures of binary mixtures, to van der Waals' equation of state, to the formulæ and theories used in electrochemistry, and to the calculation of potentials of liquids, which are now used in physiological investigations He was also the author of several books on thermochemistry, electrochemistry, the equation of state, and a well known volume entitled "Six Lectures on Thermodynamic Potentials" His work has perhaps not received everywhere the attention which it merits This may be due to some extent to the extreme intricacy of the problems with which he has dealt But although his mathematical investigations of binary and ternary mixtures may not be easy to follow, the results are often relatively simple Van Laar indeed rendered a great service by his masterly application of strict thermodynamical principles and the equation of state to the problem of co ordinating mathematical theory with experimental results As might be expected, his work provoked a good deal of criticism, and he frequently came into conflict with those who attempted to adapt to concentrated mixtures laws which are only applicable to dilute solutions His investigations upon the borderline between the solid and liquid states under very high pressures will undoubtedly have an important bearing on the solution of some geochemical problems

THE seventh annual number of *Brighter Biochemistry*, the journal of the Cambridge Biochemical Laboratory, is up to the standard of its predecessors The identity of the various contributors is but thinly veiled under the initials appended to each item For matter, the authors have cast their net wide and caught a number of well known scientific workers whose habitat is not in this laboratory The number could scarcely have been considered complete without references to the Nobel prizemen for 1929 It is probable that for a true appreciation of many of the points a personal acquaintance with the victims and their biographers is a necessary precedent, but even without this knowledge many of the rhymes can be understood by those with some idea of modern biochemical literature For an hour's quiet fun, the number can be recommended to all biochemists and physiologists as a method of retreat from scientific problems

THE successor to the ninth annual report of the Tidal Institute of the University of Liverpool is the Annual Report (1929) of the Liverpool Observatory and Tidal Institute, which now form a single institution governed by a joint committee of the Mersey Docks and Harbour Board, and the University of Liverpool The scientific staff numbers Prof J Proudman and Dr A T Doodson, as director and

associate director, with six assistants About half the income of the institution is derived from grants by the Board, the University, and the Liverpool Steam Ship Owners' Association, the remainder being obtained as payment for services rendered by the institution to outside bodies, these services consist mainly of the analysis and prediction of tides, but also of the supply of meteorological information and the testing of chronometers, sextants, and other instruments The institution has acquired the business, and the tide predicting machine, of Messrs E Roberts and Sons, Broadstairs, tidal and astronomical computers, the first machine owned by the institution was being worked almost to its full capacity The detailed account of the year's activities shows that the institution continues its valuable and highly successful combined work of practical analysis and prediction of tides, with theoretical research on tidal currents and the meteorological and other influences which affect them

IT has long been known that the currents in the mains of electric traction systems interfere, sometimes most seriously, with delicate electrical measurements carried out in laboratories and observatories It has now been proved that similar interference from electric tramways has been affecting the quality of the reception in broadcast receiving sets Some results obtained by C O Horn of the Post Office are published in *Engineering* for Feb 21 Generally, in electric tramways in Great Britain, a trolley wheel is pressed against the trolley wire At every suspension 'ear', the trolley usually gives a jump, the ensuing arc burning by a minute amount the wheel and the wire Similarly, at the section insulators which occur at every half-mile, there is an arc when the wheel passes from one section to the next Radio receiving sets in the neighbourhood hear a click every time an arc is formed Tests made at Blackpool prove that if the trolley wheel be replaced by a Fischer plate similar to those usually employed on the continent, much of the noise is eliminated Tests were made at Birmingham with another type of collector, but the results were not so good as those obtained by the Fischer plate It was apparent that most of the interference was due to causes outside the collecting system Satisfactory results were obtained by transposing the coils of the traction motor so that they came between the trolley wire and the armature instead of between the armature and the rails. In the new position, the coils act as a high frequency choking coil and so prevent the formation of oscillatory currents

THE nineteenth report of the Development Commissioners for the year ending Mar 31, 1929, has recently been published by H M Stationery Office It is arranged in four sections, the first two of which are concerned with advances in agriculture, rural economy, fisheries, and harbours The third part relates to action taken in connexion with the compulsory acquisition of land for road improvement, while the fourth deals with the financial position of the Development Fund The successful establishment of the eight new Imperial agricultural bureaux was one of the chief features of the year, their object being to act as central agencies for the collection and dissemination of information on the various branches of agricultural research An important step in determining the practicability of extending electrification into rural areas has been taken in a trial scheme started in Bedfordshire, from which it is hoped to calculate the probabilities of success in other areas With regard to research and education, each of the institutes and advisory centres is dealt with in turn and an account of the investigations in progress given in some detail In the rural economy section, the work of the community councils and their organisation for the development of rural industries seems to be giving encouraging results Reports are also supplied of the work at the various marine biological institutions and of the special investigations 'directed' by the fishery departments of the Ministry The grants and loans made during the year are quoted in detail, and the report concludes with three appendices, in which a list of all work published by members of the staffs of institutions receiving financial support from the fund is given

THE honorary membership of the Academia Scientiarum Fennica, Helsingfors, has been conferred on Sir J C Bose for his contributions in advancement of knowledge of life reactions in plants

THE G J Symons memorial lecture of the Royal Meteorological Society will be delivered on Mar 19 by Dr Herbert Lapworth, who will take as his subject, "Meteorology and Water Supply"

THE following appointments in the Colonial Agricultural Services have recently been made by the Secretary of State for the Colonies Dr W, Youngman to be director of agriculture, Ceylon, Mr E J Wortley, director of agriculture, Nyasaland, to be director of agriculture, Trinidad, Mr F Burnett, divisional agricultural officer, Ceylon, to be deputy director of agriculture, British Guiana, Dr F J Martin, agricultural chemist, Sierra Leone, to be assistant director of agriculture, Sierra Leone, and Mr R W Donkin to be produce inspector, Nigeria

THE governors of the Scottish Woollen Technical College, Galashiels, have elected Dr A W Stevenson, of the British Research Association for the Woollen and Worsted Industries, as colleague and successor to Dr Thos Oliver, who wishes to retire from the principalship in 1931 Under Dr Oliver, wool textile education in Galashiels has grown from a local evening class to a well equipped mono technical institution controlled by and serving the whole Scottish woollen industry He was also a pioneer in wool textile research, that being the subject of his degree thesis more than twenty years ago Since the war, Dr Stevenson's principal work has been connected with problems in worsted spinning The high standard of this work was recognised by the University of Edinburgh in 1928, when the degree of Doctor of Science was awarded to him on a comprehensive thesis embodying the main points of his investigations

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A senior secretary in the Matriculation and School Examinations Department of the University of London—The

Principal, University of London, South Kensington, S W 7 (Mar 22) Examiners in the following subjects for the Matriculation Examination of the University of London for 1931 Chemistry, French, Geography, German, Latin, Modern History, Physics, Spanish—The Secretary of the Matriculation and School Examinations Council, University of London, South Kensington, S W 7 (Mar 27) A professor of pathology and bacteriology at the Calcutta School of Tropical Medicine—The Secretary to the High Commissioner for India, Education Department, India House, Aldwych, W C 2 (Mar 27) A chief sanitary officer for the Asansal Mining Settlement under the Asansal Mines Board of Health, Burdwan District, Bengal—The Secretary to the High Commissioner for India, General Department, India House, Aldwych, W C 2 (Mar 29) An assistant horticultural instructor at the Hertfordshire Agricultural Institute, Oaklands, near St Albans—The Clerk of the County Council, 28 Castle Street, Hertford (Mar 29) A woman lecturer in biology at the Avery Hill Training College, Eltham—The Education Officer (H 2/1), County Hall, Westminster Bridge, S E 1 (Mar 31) A Bernard Baron research student in the Ferens Institute of Otolaryngology of Middlesex Hospital—The Secretary, Middlesex Hospital Medical School, W 1 (April 7) A professor of physiology at Bedford College for Women—The Academic Registrar, University of London, South Kensington, S W 7 (April 15) A lecturer in the chemistry of cellulose at the Manchester Municipal College of Technology—The Registrar, College of Technology, Manchester (April 21) A woman assistant lecturer and demonstrator in botany at the Royal Holloway College—The Principal, Royal Holloway College, Englefield Green, Surrey (April 24) A whole time medical registrar for the Society of Apothecaries of London—The Clerk, Apothecaries Hall, Water Lane, Blackfriars, E C (April 30) A director of the Institute of Plant Industry, Indore and Agricultural Adviser to States in Central India and Rajputana—The Secretary to the Board of Governors, Institute of Plant Industry, Indore, India (Aug 31) An assistant master (a graduate in engineering with emphasis on electrical engineering) in the Junior Technical School of the Maidstone Technical Institute, and for evening classes—The Principal, Technical Institute Maidstone An assistant secretary of the British Association for the Advancement of Science—The Secretary, British Association, Burlington House W 1

Our Astronomical Column

Comets—*Popular Astronomy* for February contains a photograph by Prof G van Biesbroeck of Wilk's comet taken on Dec 31, 1929 The tail extends as a narrow ribbon to the edge of the plate 1° 36 from the nucleus There are fainter tails, about 40′ long, on each side of it There is a bright circular coma, some 4′ in diameter, with a fainter border On Jan 22 the tail lagged 5° or 6° behind the prolongation of the line from the sun to the comet

Prof van Biesbroeck is still observing two other faint comets, 1927 IV, Stearns, the magnitude of which is now 16, and 1925 II, Schwassmann Wachmann (1) A photograph on Dec 28 showed it as a circular nebulosity 1′ in diameter with a brighter central condensation 20″ in diameter Its magnitude was 15 A visual observation with the 40 inch refractor on Dec 30 gave a diameter of 25″, the faint outer border being invisible to the eye

Saturn—*L'Astronomie* for January contains an illustrated article on Saturn by M E M Antoniadi Most of the drawings were made by him with the great Meudon refractor between 1927 and 1929, but a few older ones are reproduced Stress is laid on the dusky polar caps, the author concludes that the irradiation produced by the brighter regions between the poles and the temperate zones causes them to appear to bulge out beyond the elliptical outline and so produce the 'square shouldered aspect' noted by Sir William Herschel and by many later observers Drawings made in July and August 1927 show some spots, both bright and dusky, breaking the regularity of the belts, some of these look definite enough to use for obtaining values of the rotation period, of which there are not very many determinations, this question is not, however, discussed in the article It is noted that these markings are much less permanent than on Jupiter, where the Great Red Spot has now persisted more or less visible for half a century

Plans for the 200-Inch Telescope—The *Scientific Monthly* for January contains an article by Dr Elihu Thomson on the plans and experiments that are now in progress with regard to this proposed gigantic telescope The use of glass for the great mirror is considered impracticable, hopes are entertained that fused quartz will prove suitable, one great advantage is the much smaller coefficient of expansion Dr Thomson describes some experiments on a small scale in which mirrors of glass and quartz were compared, the image of an artificial star was almost instantly shattered on applying heat to the back of the glass mirror, the quartz one reached a much higher temperature before the image was much distorted The main body of the proposed great mirror would be formed by fusing a great mass of quartz sand in an electric furnace at a temperature of 1700° 1800° C This would contain bubbles on cooling, but it is not considered that these would do much harm On this block a surface of clear glass like fused quartz, or silica glass, would be deposited A method of doing this has been arrived at, a quantity of finely powdered crystal quartz is poured through a very hot oxy hydrogen jet, which melts it It falls in this state on the face of the mirror, where it solidifies in a transparent deposit The process is compared to the deposit of clear ice on objects during a sleet storm Small mirrors have already been successfully made, and some of these may be of use as the subsidiary mirrors which will be required in the proposed telescope It is thought that at least three years will be necessary for the production of the great mirror, even before the figuring begins There will be the advantage in the figuring that the heat produced by friction will not distort the figure so much as in the case of glass, in that case, frequent pauses have to be made to allow the glass to cool Dr Thomson states that the General Electric Company at West Lynn has offered to make the mirror merely at the cost of the labour and material

Research Items

Cultural Areas in Africa.—In *Africa* for January, Dr. Melville J. Herskovits applies to the ethnological problems of Africa the American method of 'cultural areas'. He suggests nine cultural areas: (1) Hottentot: essentially a herding culture but differing from the Bantu, in that there is no agriculture, and the women have much to do with the herds. The cattle are given as gifts in marriage, but for the wedding feast, not as a dower. The language, with that of the Bushmen, is differentiated by the 'click'. (2) The Bushman: with poor material culture, but high artistic and literary (folklore) ability. The dog is the only domesticated animal, and hunting is brought to a high degree of skill. (3) The East African cattle area: cattle determine a man's position and prestige, and are utilised in all the important ceremonials of life; but they do not furnish food, excepting milk, or when eaten as a ceremonial offering or after they have died. Food is obtained from the produce of the fields, and is the work of the women, to whom the care of the cattle is forbidden. Polygamy prevails, being based on the number of cattle a man commands. (4) The Congo: predominantly agricultural. The people live in rectangular houses, make bark cloth, use masks, practice cicatrisation, and carve human representations. The secret society is important. (5) The East Horn: not sharply differentiated, but shades off from East Africa. The camel and horse slowly take the place of cattle—a marginal area. (6) The eastern Sudan: a nomadic culture organised around live stock. Living in a hard desert area, their first care is the feeding and watering of their animals. The religion is Mahommedanism and the social order is strongly paternal. Clothing is of cloth and the people live in tents. (7) The western Sudan: a marginal area, in which great kingdoms—Benin, Bornu, Haussa—have risen. The economic life is basically herding, agriculture, and trade. (8) Desert: a nomadic area dependent upon trade, camel and horse breeding. (9) Egypt: an area distinct from the rest of Africa, of which the influence on other African culture must have been profound.

Preservation of Fruit and Vegetables.—One of the difficulties in the fruit and vegetable trade is the tendency for periods of scarcity to alternate with seasons of plenty when the market may be glutted with perishable produce, which must be sold at once or thrown away. In such a case the preservation of the surplus for future sale prevents instability of the market and presents the consumer with a constant source of supply of perfectly satisfactory foods, containing all the food values of the fresh materials and often many of the vitamins as well. At the request of the Ministry of Agriculture and Fisheries, the workers at the University of Bristol Research Station, Campden, have compiled a short monograph on the subject of the domestic preservation of fruit and vegetables (Ministry of Agriculture and Fisheries Miscellaneous Publications, No. 69, "Domestic Preservation of Fruit and Vegetables". London: H.M. Stationery Office, 1929. 1*s*. net). After a short chapter on the theory of preservation, practical details, including numerous recipes, are given for fruit canning and fruit bottling, for jam making, for the preparation of fruit jellies and syrups, and of candied, crystallised, and glacé fruits, for the preservation of vegetables, the drying of fruit and vegetables, and the preparation of chutneys and pickles. Many of the recipes given are based on those which have been in use in domestic households for many generations. The methods described can be used by the housewife or by the manufacturer.

Artificial Ripening of Bananas.—Bananas for export are gathered unripe and their proper maturation afterwards is an important commercial problem, investigations upon which have been undertaken by the Australian Council for Scientific and Industrial Research (*Jour. for Sci. and Indust. Res.*, Commonwealth of Australia, vol. 2, 1929, p. 219). It is recommended that at first the store should not be ventilated, though its air should be kept in motion by a fan, and a temperature of 68° F. and a relative humidity of 85-90 per cent maintained. An addition of coal gas night and morning, in the proportion of one part to 2000 parts of air, is found to accelerate the ripening and to produce more uniform ripening throughout the bunch, probably by means of its ethylene content.

Methods of Tagging Fishes and Crustacea.—With the view of tracing the migratory habits of commercial fishes and the Cape crawfish (*Jasus lalandii*), Dr. Cecil von Bonde (*Fisheries and Marine Biological Survey*. Report No. 6. For the Year 1927–1928. Special Report No. 2. Pp. 1-7 and No. 3. Pp. 1-5) has made use of aluminium tags fixed to the upper lobe of the caudal fin, covering the base of the caudal rays, and finds that these function quite effectively. They are fixed to the fish by means of a pair of tongs, which are figured. He also suggests that there is reason to suspect the spawning ground of the South African eels to be in the deep waters of the Indian Ocean. The difficulty of marking Crustacea, which undergo periodic ecdysis, is overcome by attaching aluminium tags through the ventral flexor muscles lateral to the mid-ventral line, thus avoiding the nerve cord and the blood vessels. Preliminary tests of this method have been successful.

Pycnogonida of South Africa.—Prof. Thomson Flynn has described the important forms obtained from South African waters (Fisheries and Marine Biological Survey. Report No. 6. For the Year 1927–28. Special Report No. 1. Pp. 1-36. The Government Printing and Stationery Office, Pretoria, 1928). Of nineteen species examined, only nine had been described previously. The new species *Nymphon bipunctatum*, *N. natalense*, *N. comes*, *Parapalene calmani*, *Pallenopsis intermedia*, *Pseudopallene gilchristi*, *Anoplodactylus pelagicus*, *Phoxichilidium capense*, *Pycnogonum forte*, and *Tanystylum ornatum* are figured and described. It is interesting to note that as many as thirty-five specimens comprising four species have been captured by a tow-net off Port Natal and that "all the species are of slender fragile type with long limbs, such as may be expected to be good swimmers". *Pallenopsis ovalis*, which has been recorded by Loman from the East Indies, by Calman from the Andamans and from Ceylon, and *Parapallene nierstraszi* by Loman from the East Indies, were obtained from the west and south-west coasts, thus suggesting an obvious relationship between the Pycnogonid fauna of South Africa and the East Indies. This is probably due to the course of the equatorial current, which also exists on the east coast of Australia.

Earth Evolution.—The *Journal* of the Washington Academy of Sciences, vol. 20, pp. 17-25, Jan. 18, 1930, contains an interesting article by B. Gutenberg on "Hypotheses on the Development of the Earth". The ideas involved are to be more fully explained and developed in a future volume (3) of the "Handbuch der Geophysik". He accepts Darwin's theory of the evolution of the moon by fissure from the earth, and supposes that whereas, before this event, the earth's

crust was nearly in hydrostatic equilibrium, afterwards the outer sialic shell was absent from the part whence the moon was removed, so that the hydrostatic equilibrium was completely disturbed In the Carboniferous epoch, some degree of quiet seems to have been restored, but at this time nearly the whole complex of continents was a single block situated in the southern hemisphere Under the action of hydrostatic forces, this block separated into pieces which began to drift apart, and do so even to day, at the same time, the *Polflucht* forces tended to move the whole mass so that about equal parts lay on the two sides of the equator This having been accomplished, no further large movement of this block as a whole is to be expected, though the continents will continue to spread out and the surface of the extending regions will tend to sink, as is perhaps exemplified in the sinking of the western coast of Europe

Collisions between Very Slow Electrons and Molecules—In two recent papers in the *Annalen der Physik* (vol 3, p 536, and vol 4, p 91) C Ramsauer and R Kollath have given an account of some new work upon the collisions of very slow electrons with gaseous atoms and molecules Using the original form of apparatus devised by Ramsauer, they have now been able to study the motion of the electrons for speeds equivalent to a fall of potential of only one sixth of a volt Their results again show a dissimilarity between the behaviour of different gases Amongst the inert gases, the effective area of helium changes little with the speed of the incident electron, whilst the area of neon decreases continually with fall in electron velocity Argon, krypton, and xenon, on the other hand, have a single minimum in the area velocity curves, a property shared by oxygen and by methane The curves for nitrogen and the oxides of carbon are more complicated The maxima and minima on these curves occur in general at potentials which are far below the critical potentials of the gases, the small irregularities on the curve for helium, for example, being at about one volt, whilst its lowest excitation potential is just below twenty volts The authors suggest that the area velocity curves for all gases may be found to have a minimum even where this has not already been found, when the great technical difficulties in the way of working with electron speeds less than 0 16 volt can be overcome

Extreme Ultra-Violet Spectra—Further details of the important work of B Edlén and A Ericson on extreme ultra violet spark spectra (see NATURE, Nov 2, 1929, vol 124, p 688) are given in the *Zeitschrift für Physik* for Jan 21 The spectrograph designed for this purpose by Prof Siegbahn is relatively simple in construction, the spark chamber being a modified Siegbahn metal X-ray tube exhausted from one lead of a pump, the other lead from which evacuated the main chamber of the instrument The grating used had a radius of curvature of 101 cm, and was ruled over an area of 35×50 mm^2, the ruling being performed at the National Physical Laboratory, Teddington The plates used for photographing the spectra were Schumann plates with glass only 0 4 mm, in thickness, these being considered preferable to several other types of plates and films that were tested More reproductions of spectra are given than were shown in NATURE, perhaps the most interesting of which are enlargements of two multiplets at 834 A and 1175 A taken in the first order, which show very well the detail which can be recorded, the two lines at 832 75 A and 832 92 A being clearly separated A note added in proof states that it has now been found possible by the use of a more intense spark as source to push the limit of the spectra still farther into the ultra violet (see NATURE, Feb 15, 1930, p 233) The first members of the hydrogen like spectra of doubly ionised lithium (Li III) and of trebly ionised beryllium (Be IV) have been found at 135 02 A and 75 94 A respectively, and considerable extensions of the spectra of doubly ionised beryllium (Be III) and of the third, fourth, and fifth spark spectra of aluminium have also been made in the same region

Oxides of Nickel—Measurements of the heats of solution in sulphuric acid of nickel hydroxide and of its various oxidation products, the results of which are given by Giordani and Mattias in the *Rendiconti dell' Accademia delle Scienze Fisiche e Matematiche di Napoli* (1929), indicate the existence, between NiO and Ni_2O, of two intermediate oxides Of these, the one with the higher content of active oxygen determines the characteristic potential of the anode during the greater part of the discharge of the alkaline accumulator

Respiration Apparatus—This assembly of apparatus for indirect calorimetry, designed by Dr E Simonson, of Frankfort a M and manufactured by Askania Werke A G, of Berlin Friedenan (London agent, O G Karlowa, Abford House, Victoria, S W 1), differs but slightly from existing models such as the Douglas Haldane equipment A diverting manifold (see Fig 1 8 12) is attached directly to the mouth

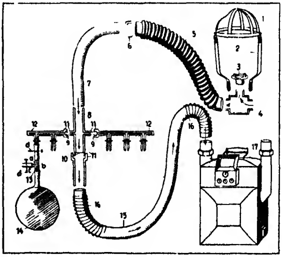


FIG 1

piece (4), permitting of the sampling of expired air for analysis in either a rubber or cellophane bag (14), while the volume of expired air is obtained from the dry meter (17) A variety of orifice plates with packing rings (9) are available with capillary metal tubes which can be closed individually, thus enabling the removal of short or continuous samples (about 1 litre) of the expired air in a protracted experiment The volumes per unit time of these samples, naturally, will depend on the cross sectional areas of the orifices, which are always predetermined It thus becomes possible to withdraw samples for analysis at any stage of the experiment and to measure the basal metabolic rate before and after the experiment The diverting manifold is obtainable in a portable form for strapping on the back and weighs about 2½ lb The apparatus may find application in experiments of long duration where the more expensive chambers or closed circuit assembly are at present used

Recent Work on Vitamin A

DURING the past two years advances have been made in our knowledge of the chemistry and properties of vitamin A and its relationship to certain other compounds, but progress, though steady, has not been so dramatic as in the case of vitamin D Attention has been directed chiefly to methods of assay, both biological and chemical, to attempts at isolation of the vitamin, and to its formation under natural conditions less work has been devoted to its physiological functions In this article certain aspects of the subject will be briefly reviewed

ASSAY

The tediousness and inherent difficulties of the biological test have led investigators to seek some simple chemical reaction or some physical property which could be utilised for the quantitative determination of the vitamin However, since these methods are not absolutely specific, the final criterion must be the animal test, so that its accuracy has been critically considered and its technique improved, in the hope of obtaining more reliable results

The arsenic trichloride test of Rosenheim and Drummond (*Biochem J*, vol 19, p 753, 1925) and the antimony trichloride test of Carr and Price (*ibid*, vol 20, p 497, 1926) have been widely used, more especially the latter, since the blue colour produced lasts somewhat longer than that given by the former reagent Certain precautions have to be observed in carrying out the test, since the proportionality between the amount of vitamin A containing oil taken and the blue colour developed is not linear except possibly over a small range of concentrations It is necessary, therefore, to find the amount of oil which will give a standard depth of colour, since the blue is usually mixed with other colours, it is most conveniently measured in Lovibond tintometer units It is also essential to standardise the reagents and the temperature the amount of oil present influences both the rate of development and of fading of the colour (N Evers, *Quart J Pharmacy and Pharmacol*, vol 2, p 227, 1929 T T Cocking, *ibid*, p 310 E R Norris and I S Danielson, *J Biol Chem*, vol 83, p 469, 1929) With cod liver oil, good agreement has been obtained between the colorimetric and biological methods, but the presence in animal fats of other substances giving the blue colour with antimony trichloride interferes with the direct quantitative estimation of the vitamin Thus both carotin and xanthophyll give a deep permanent blue under the conditions of the test Willimott and Wokes (*Lancet*, vol 2, p 8, 1927) removed the interfering pigments by adsorption on charcoal, and found good agreement between the two methods of assay in the case of a variety of vegetable and animal foodstuffs The blue colour can be distinguished also by spectroscopic examination thus in the case of vitamin A with the $AsCl_3$ reagent, there is a band at 5870 A, with a second band, developing on standing, at 4750 A, with the $SbCl_3$ reagent the initial band is at 6140 A and the second at 5300 A in both cases the initial bands rapidly fade Carotin, however, gives a band at 5900 A and the colour produced is duller and greener (Rosenheim and Drummond, loc cit, Wokes, *Biochem J*, vol 22, p 997, 1928 Moore, *Lancet*, vol 2, p 219, 1929) Blue colours are also given by other compounds, but under conditions in which they are not likely to be confused with that given by vitamin A thus both cholesterol and cholic acid, after treatment with benzoyl chloride in solution in chloroform, give a blue colour with $AsCl_3$ (Rosenheim, *Biochem J*, vol 21, p 386, 1927 Wokes, *ibid*, vol 22, p 830, 1928) The cholesterol oxidation product has none of the properties of vitamin A, fails to give the colour after solution in oil, and has no stimulating effect on growth

The absorption spectrum of cod liver oil shows bands at 3200 3280 A and 2700 2900 A Morton and Heilbron (*Biochem J*, vol 22, p 987, 1928) have found that the intensity of the former band varies with the intensity of the blue colour developed in the $SbCl_3$ test, both in natural oils and concentrates, and also in oils oxidised or irradiated when the band disappears and no blue colour is obtained Other compounds may show a band near 3200 A their presence is disclosed after oxidation of the oil Although the intensity of this band may, under certain conditions, be used as an estimate of the concentration of vitamin A in the oil, yet it is not absolutely specific for the vitamin, so that it cannot be relied on as sole test, without an accompanying biological assay, in the case of materials from which the presence of interfering substances has not been excluded Rosenheim and Webster (*ibid*, vol 23, p 633, 1929) have, in fact, shown that dehydroergosterol has an absorption band at 3200 3280 A, but gives no blue colour with $AsCl_3$ or $SbCl_3$, and is inactive in doses up to 1 mgm per diem when given to rats maintained on the standard deficient diet The intensity of the band, however, is considerably less than that of the absorbing substance in cod liver oil

A number of workers have analysed the responses of their animals, the growth of which had ceased on a vitamin A deficient diet, to various supplements containing the vitamin It is now agreed that such a diet must contain vitamin D, and that results obtained on diets deficient in both vitamins A and D cannot be relied on to give even a rough idea of the vitamin A activity One of the difficulties of the usual method of assay is that when growth ceases the rat is frequently suffering from some infection, and that a supply of vitamin A may fail to stimulate growth until the infection has cleared up, or if the dose is too small, the animal may succumb to its infection Coward and Key (*ibid*, vol 22, p 1019, 1928) find that the responses of depleted animals fall into four groups there may be no response, on too small a dose, there may be subnormal quantitative growth, with or without premature slackening, on a small dose, or there may be normal growth, with premature slackening or to maturity, according to the size of the dose given Sometimes a growth response only occurs after a latent period of some weeks They consider it necessary to use 2 4 animals on each dose with a test period of 8 weeks Hume and Smith (*ibid*, vol 22, p 504, 1928) report similar results they are of opinion that it is possible to obtain a qualitative result by this method, and possibly in the first 3 4 weeks of vitamin A feeding after a depletion period, to attain a quantitative assay They consider that a better method is to give the animals small doses of vitamin from the beginning of the experiment the growth curves are graded according to the size of the dose, but a result cannot be looked for in under 3 months

Drummond and Morton (*ibid*, vol 23, p 785, 1929) found the growth responses of different animals on the same doses to vary considerably up to twelve animals on each dose, with an extensive range of doses, must be used to obtain a distinction between two cod-liver oils differing from each other by less than 100 per cent Only the growth rates for the first 5-6 weeks following the depletion period should be considered better results are obtained when doses necessary to give a growth rate of 3 grams per week

are compared than when comparison is made between rates of growth on the same dose These authors hold, however, that for quantitative estimation of vitamin A in cod liver oil, the colour test or the determination of the intensity of the absorption band gives more reliable results than the biological assay Similar analyses have been published by Nelson and Jones, and Sherman and Burtis (*J Biol Chem*, vol 80, p 215, and vol 78, p 671, 1928) Smedley Maclean and her co workers (*Biochem J*, vol 23, p 634, 1929) suggest that doses of the substance under test which will just sustain life over a certain time, and those which just fail to do so, should be determined, since a better comparison between different samples can be made thus Furthermore, as a check upon the response of the animal, a dose of cod liver oil which might be expected to stimulate growth should be given at the end of the experiment

In connexion with biological assays, some recent work by Coward and her collaborators may be referred to (Coward *et al*, *Biochem J*, vol 23, pp 695 and 913, 1929) Rats sometimes fail to grow on an apparently complete synthetic diet, the failure has been traced to the casein employed, since changing the casein permits of normal growth This work may explain some of the irregular results which are observed at different times in vitamin A (and B) assay

CHEMISTRY

Drummond and Baker (*Biochem J*, vol 23, p 274, 1929) have investigated the chemical nature of vitamin A Unsaponifiable matter was prepared from the liver oils of the cod, sheep, and Greenland and Japanese sharks Cholesterol was removed by crystallisation only small amounts were present in the shark liver oils, the chief constituents being selachyl, batyl, chimyl, and oleyl alcohols, some of which were removed in part by crystallisation from suitable solvents The residual oils were then submitted to fractional distillation at very low pressures no satisfactory fractionation was obtained in the case of cod or sheep liver oils, and in both cases decomposition occurred recovery of the vitamin from the fractions was only 2 and 11 per cent respectively, as estimated by the colour test Distillation of the shark liver oils yielded only the higher alcohols, but the vitamin recovery was up to 50 per cent in the case of the Japanese shark liver oil It is considered that the destruction of the vitamin in the former case is due to the presence of complex alcohols and hydrocarbons of the terpene series, which are only present in small proportions in the shark oils No fraction consisting exclusively of vitamin A was obtained, nor was it separated by crystallisation It appears that it is present in Japanese shark liver oil to the extent of 1 per cent only, or less, of the unsaponifiable matter The authors are of opinion that it is probably a sterol, from the nature of its colour reactions, and suggest that its chemical composition may be elucidated rather by studying the properties of sterols than by attempting its isolation from a natural source

In connexion with the destruction occurring on distillation at low pressures, it may be mentioned that Wokes and Willimott (*ibid*, vol 21, p 419, 1927) suggest, as a result of experiments on the effect of heat and oxidation on the vitamin A content of cod liver oil, that the destruction observed may be due to the presence of volatile organic peroxides

In the identification of the complex alcohols present in liver oils, it is often necessary to hydrogenate the material and isolate the reduced products Drummond and Baker (loc cit) found that reduction of the oil obtained from the unsaponifiable matter of cod-liver oil, after removal of sterols by digitonin, did not destroy completely the vitamin A content, but the reduction was admittedly incomplete Nakamiya and Kawakami (*Sci Papers, Inst Physical and Chem Res*, vol 7, p 121, 1927), however, found that hydrogenation of 'Biosterin' led to complete loss of the vitamin activity

Another line of approach to the chemical nature of vitamin A has been the study of its relationship to certain plant pigments Xanthophyll has been shown to have no growth promoting power (Willimott and Moore, *Biochem J*, vol 21, p 86, 1927 Smedley Maclean *et al*, *ibid* vol 23, p 634, 1929), but several observers (v Euler, Maclean, Moore) have found that carotin in very small doses can restore normal growth in a rat maintained on a vitamin A deficient diet

Collison, Hume, Smedley Maclean, and Smith (*Biochem J*, vol 23, p 634) have investigated the nature of the vitamin A constituent of certain green leaves The material soluble in light petroleum was extracted from green cabbage and saponified the yield was 0 84 per cent of the dried leaves The unsaponifiable matter was fractionated by means of solvents cold alcohol extracted a sterol together with a substance giving the blue colour with antimony trichloride hot alcohol extracted from the residue nonacosane and di *n* tetradecyl ketone whilst from the final material carotin was obtained by extraction with light petroleum the carotin had definite growth promoting power even in a daily dose of 0 003 mgm From white cabbage little carotin was obtained, and this material contained little vitamin A Carotin prepared from spinach and carrots was also active, in doses of 0 01 mgm daily, but it was obtained in a somewhat less pure condition than when cabbage was used as source The authors consider that possibly more than one substance can function as vitamin A, that, in fact, the growth promoting power is the property of a special grouping of atoms which may occur in several different molecules they cite the observations of v Euler and his co workers, who have shown that dihydro α crocetin is also active Moreover, the absorption spectra of the blue colours produced by vitamin A and carotin with $SbCl_3$ are different, but no trace of the former appears in that of an active sample of carotin, suggesting that vitamin A is not simply a contaminant of the latter It is possible that the negative results of Drummond as regards the potency of carotin are due to the fact that his basal diet is free from fat There is evidence that some constituent of the unsaponifiable fraction of the fat is necessary for carotin to exert its growth promoting power

Moore has also found that carotin can exert a vitamin A activity (*Biochem J*, vol 23, p 803, 1929 *Lancet*, vol 2, p 380, 1929) His results confirm those obtained by other workers, who have found carotin active, but his latest experiments have led to a different conclusion Carotin was fed to rats in daily doses of from 0 0001 to 0 75 mgm, after 5 weeks the animals were killed the fat extracted from the liver and analysed for vitamin A by colorimetric and spectroscopic methods The intensity of the vitamin A blue reaction (absorption band at 6100 6300 A) indicated that a daily dose of 0 01 mgm or more of carotin increased the vitamin A content of the liver at the same time only a very slight increase in the degree of yellow pigmentation of the fat occurred, showing that carotin was stored to only a negligible extent in this organ Hence, even when a large excess is ingested, carotin appears in the liver only in minute traces, the simplest explanation of the increase in the vitamin A content is that it was actually formed from a portion of the carotin eaten

In a recent review Drummond points out that the

ordinary standards of chemical purity give insufficient security in biochemical work with substances so highly active as the vitamins (*Chem and Industry*, vol 49, p 1 T, 1930) The difficulties experienced in detecting ergosterol as the impurity in cholesterol which is activated by exposure to ultra violet light need scarcely be referred to in this connexion In this case, the doubt is as to the purity of the carotin used by the various investigators who have found it to contain growth promoting activity Drummond has obtained carotin of melting point so high as 185° it showed no vitamin A activity even in relatively large doses He has also prepared di hydro-α crocetin his specimen failed to restore growth in rats deprived of vitamin A From the results obtained with liver oils, it may be estimated that the daily dose of the vitamin for a rat is probably less than 0 0001 mgm , an order of activity comparable with that of vitamin D If this is so, preparations of vitamin A which must be given in larger doses to restore growth must necessarily be impure

PHYSIOLOGY

The presence of vitamin A in the diet is essential if it is to be adequate for growth and the maintenance of normal health E Mellanby has stressed the latter function without vitamin A in the food, infections occur regularly among the experimental animals administration of large quantities to human beings may cure certain infections (see NATURE, vol 122, p 750, 1928) It must be assumed that vitamin A is, or is the precursor of, an essential constituent of certain cells of the body without it they can neither multiply nor maintain their normal structure In many cases the onset of an infection appears to be facilitated by an alteration in the cells lining an exposed surface when the vitamin is withdrawn from the diet

Unlike vitamin D, vitamin A is not synthesised in the animal body hence it is important to see that it is present in the food Thus the content of cow's milk in this vitamin depends on the food given the animal, it is increased by feeding green food and cod liver oil The vitamin D in the milk can be increased by giving it in the food or by irradiating the cow or even the milk itself

Yeast, a source of many interesting compounds, does not contain vitamin A previous conclusions to the contrary were the result of using a diet deficient in both vitamins A and D in testing for this vitamin (Hume, Smith, and Smedley Maclean, *Biochem J*, vol 22, p 27, 1928)

The ultimate source of vitamin A is the green plant there has been considerable doubt as to whether the presence of light is necessary for its formation or not, partly owing to the difficulty of excluding all light, partly owing to the fact that many tests have been carried out using a basal diet deficient in both vitamins A and D The most recent work indicates, however, that vitamin A can be formed in the complete absence of light, except the minimum required to feed and handle the animals and collect the etiolated shoots Moore found that wheat seeds contained no vitamin A, that etiolated shoots fed to rats in a diet containing vitamin D but no A stimulated growth, although given to the animals after dark, and finally that the same result was obtained when no light except red was admitted to the room in which the animals were housed and the shoots grown throughout the experiment (*ibid*, vol 21, p 870, 1927, vol 22, p 1097, 1928) It is, however, possible that the brief exposure to the red light may have been the essential factor in the production of the vitamin it is certain that light can accelerate the synthesis, since green plant tissues are better sources than white

Education and Science in the Civil Service Estimates

THE Civil Estimates and Estimates for Revenue Departments (Vote on Account) for the year ending Mar 31, 1931, have been issued (82 London H M Stationery Office 3*d* net) The total of the estimates for the full year is £368,095,208, against a total of £320,190,105 voted for the current year, this latter total, however, includes supplementary estimates

The items in which readers of NATURE will be most interested occur in Classes IV and VI, and are as follows

	Total Estimate for 1930 (Net)	Total Net Estimate for 1929 (adjusted for transfers)
Class IV		
Board of Education	£45,495,653	£41,685,899
British Museum	297,263	283,559
Scientific Investigation, etc	232,303	228,278
Universities and Colleges, Great Britain	1,830,000	1 550,000
SCOTLAND		
Public Education	7,197,422	6,173,485
Class VI		
Ministry of Agriculture and Fisheries	2,312 310	2,953,863
Beet Sugar Subsidy, Great Britain	5,400,000	4,250 000
Surveys of Great Britain	143,203	140,980
Forestry Commission	837,800	600,000
Development Fund	625,000	300,000
Development Grants	200,000	—
Department of Scientific and Industrial Research	469,278	446,214
SCOTLAND		
Department of Agriculture	574,918	484,047
Fishery Board	137,442	68,895

The details of Class IV estimates are now available (83 IV London H M S O 1*s* 3*d* net) Under the heading "Scientific Investigation, etc", there is an increase of £4025 over last year's estimate The position is shown in the following table

GRANTS IN AID	1930	1929	Increase
Royal Society	£10,000	£10,000	—
Royal Geographical Society	1,250	1,250	—
Royal Society of Edinburgh	600	600	—
British School at Athens	500	500	—
British School at Rome	500	500	—
Royal Scottish Geographical Society	200	200	—
National Library of Wales	25,334	25,333	£ 1
National Museum of Wales	28,000	27,000	1,000
Solar Physics Observatory	3,000	3,000	—
North Sea Fisheries Investigation	1,150	1,150	—
Royal Academy of Music	500	500	—
Royal College of Music	500	500	—
Royal Academy of Dramatic Art	500	500	—
British Academy	2,000	2,000	—
Central Library for Students	3,000	—	3,000
Medical Research Council	148,000	148,000	—
OTHER GRANTS			
Edinburgh Observatory	7,269	7,245	24
	£232,303	228,278	4,025

Under the heading "Universities and Colleges, Great Britain", there is an increase of £280,000, the greater part of which, £243,110, is put down as unallocated grant

The detailed estimates for Class VI, departments dealing with trade and industry, have also been issued (83-VI London H M S O 3s net) From these it appears that grants for agricultural education and research are increased on those of the current financial year by £165,410, the largest parts of which are £93,400 for agricultural education and £67,760 for grants for research The Fisheries Department estimate shows an increase of £87,519, this is largely accounted for by the provision of £80,000 for the construction of a new vessel for deep sea research and investigation

The estimates for the Forestry Commission show a net increase of £101,800, a large item here is the increase of £29,840 under the heading of forestry operations, the greater part of which is for the acquisition of land, buildings, and standing timber

The Department of Scientific and Industrial Research estimate shows a net increase of £23,064 over that for the current year Grants for investigation and research, distributed on the recommendation of the Advisory Council, are increased by £5250, and a special grant of 100,000 francs (£4000) is to be made to an international fund for the erection and endowment of a scientific station on the Col de la Jungfrau

The staff of the National Physical Laboratory is to be increased by nine, building research requires ten more officers, chemical research five, food investigation nine, forest products six, fuel research, including physical and chemical surveys, ten, radio research eight

University and Educational Intelligence

CAMBRIDGE —The Appointments Committee of the Faculty of Biology B have appointed Dr R Williamson to be University demonstrator in pathology

The Allen Scholarship of the value of £250 has been awarded to S Verblumsky, Donaldson Bye Fellow of Magdalene College

The Appointments Committee of the Faculty of Physics and Chemistry has made the following appointments Dr F G Mann, of Downing College, to be University lecturer in chemistry, Dr J D Cockcroft, of St John's College, to be University demonstrator in physics, Dr F B Kipping, of Trinity College, to be University demonstrator in chemistry

EDINBURGH —The University Court has received with very great regret intimation from Prof Baldwin Brown of his desire to retire from the Watson Gordon chair of fine art at the end of the current academical year Prof Baldwin Brown was appointed to this chair, as its first occupant, in June 1880, and so is now about to complete his fiftieth year as professor The only previous instance of a professor serving in this University for fifty years was that of Robert Jameson, professor of natural history from 1804 to 1854, in his case, however, his lectures were delivered by a deputy during his last year of office

The Court has accepted from Sir Edward Sharpey Schafer the books, portraits, specimens, and apparatus collected by him in the Department of Physiology Mrs Kennedy Fraser has offered and the Court has accepted a collection of 280 phonograph records of Hebridean songs, made by the Isle folk themselves The collection has been made in the course of Mrs Kennedy Fraser's research work in the Hebrides during the past twenty five years

The late Mr W A Tait, son of the late Prof P G Tait, has bequeathed £50 to the Engineering Library and £100 for apparatus in the Department of Natural Philosophy

LONDON —The following doctorates have been conferred D Sc in chemistry on Mr Bhupendranath Ghosh (University College), for a thesis entitled (1) "The Rôle of Electrokinetic Potential in Colloidal Behaviour", and (2) "Action of Alkali on Stannic Oxide Sol", D Sc in physics on Mr Leslie Hartshorn (Imperial College—Royal College of Science), for a thesis entitled 'Studies in Precision Alternating Current Measurements", D Sc in mathematics on Mr W G Bickley, for a thesis entitled 'Two Dimensional Potential Problems concerning a Single Closed Boundary", and other papers, D Sc (engineering) on Mr H S Rowell, for a thesis entitled "Suspension of Vehicles and Laminated Springs", and other papers

OXFORD —The annual report of the Curators of the Bodleian Library just published contains an account of recent improvements and additions in the Radcliffe (Science) Library, which now takes rank like the Indian Institute and Rhodes House Libraries, as a Departmental Library in connexion with the Bodleian

THE Grocers' Company is again offering scholarships, each of the value of £300 a year, plus an allowance for expenses, in furtherance of original research in sanitary science Applications upon a prescribed form must be received before the end of April by the Clerk to the Grocers' Company, Grocers' Hall, E C 2

APPLICATIONS for Beit fellowships for scientific research are invited from candidates under the age of twenty five years on the date of election The latest date for the receipt of applications is April 15 Forms of application and particulars as to the fellowships are obtainable from the Rector, Imperial College of Science and Technology, South Kensington, S W 7

THE Carnegie Trust for the Universities of Scotland endows post graduate study and research by means of a scheme designed, to quote from the report of the chairman, Lord Sands, on the administration of the Trust for the year 1928–29, "to discover and if possible to supply within the limits of the Trust Deed the demand for higher study and research throughout Scotland" For the completer fulfilment of this purpose, the trustees have resolved that in future graduate scholarships which carry an annual stipend of £175 for two years may be extended for a third year with a stipend of £200, and that the value of fellowships, tenable for a maximum period of three years, shall be £300 per annum instead of, as at present, £250 It will now be possible for a Scottish graduate to be engaged in research under the auspices of the Trust for a continuous period of six years Reports on the work of investigators by Prof Arthur Smithells (physical and chemical), Prof J T Wilson (biological and medical), Sir George Macdonald (historical, economic, and linguistic), and the Superintendent of the Royal College of Physicians, Edinburgh, afford ample evidence of the value of this work Prof Smithells notes with gratification an increasing encouragement of beneficiaries to secure the great advantage of some experience in foreign laboratories During the past year, the actual expenditure for endowment of research was £17,514, grants to universities, etc, amounted to £48,020, and assistance to students in payment of class fees to £56,453 Repayments (voluntary) by former beneficiaries (31 men and 32 women) amounted to £2606, the largest amount ever received in this way in any year, and making with similar repayments in previous years an aggregate of £25,148 from 665 beneficiaries.

Historic Natural Events

Mar 17, 1669 Blood Rain at Chatillon-sur-Seine —The history of the Paris Academy of Sciences says "There fell in various parts of the city, a sort of rain, or reddish liquid, thick, viscous, and stinking, which resembled a rain of blood The prints of great drops of it were observed on walls" It is believed that this rain was composed of stagnant muddy water, raised by a whirlwind from some pond in the neighbourhood

Mar 17, 1906 Earthquake in Formosa —This destructive earthquake, by which 1266 persons were killed and 7284 houses were totally destroyed, was chiefly remarkable for the somewhat complex distortion of the ground, along a fault at least 10 miles and possibly 30 miles in length Throughout the observed length, the north part of the fault was displaced horizontally with respect to the other 2 8 ft to the east, and in the greater part was depressed by 3 4 ft At the east end, however, the vertical movement was reversed, and the south side was depressed relatively to the other by as much as 6 ft

Mar 18, 1667 Great Cold —The winter of 1666–67 was known in Germany as "the double winter", because the rivers were frozen twice January was cold, February was snowy, but the greatest intensity of the frost occurred from Mar 18 until Mar 26, with north easterly winds The Zuider Zee was full of ice, and waggons were drawn over the rivers No one remembered such severe weather so late in the season In England the winter was not especially severe, but the spring was very cold On Mar 6, Pepys wrote "The weather, too, being become most bitter cold, the King saying to day that it was the coldest day he ever knew in England", and again on Mar 7 "This day was reckoned by all the people the coldest day that ever was remembered in England" Evelyn recorded "Great frosts, snow, and winds prodigious at the vernal equinox, indeed it had been a year of prodigies in this nation, plague, war, fire [the Great Fire of London], tempest, and comet" On April 4 he added "The cold so intense that there was hardly a leaf on a tree"

Mar 19, 1719 Great Fireball —A brilliant apparition was seen from the whole of Great Britain and Ireland, Holland, and from the nearer parts of Germany, France, and Spain Halley discussed collected observations made of this meteor or fireball in *Phil Trans*, p 978, 1719 In parts of England "within doors the Candles gave no manner of Light", indeed, "for some few Seconds of Time, in all respects it resembled perfect Day" In London the path of the fireball (timed as at 8 15 P M) lay nearly in the direction of the Pleiades and Orion's belt The moon, it may be noted, was nine days old The track deduced by Halley was from over Presteigne (height 73 miles), Cardiff, Tiverton (height 69 miles) to Brest There were two explosions, the first when the fireball was over Tiverton, when the sound of it, accompanied by an air tremor causing windows and doors to rattle, was heard over an area extending from Cornwall to London, the second and greater explosion took place at the extinction of the fireball over Brittany The diameter of the fireball is stated to have been fully $1\frac{1}{2}$ miles, and its velocity along the visible part of its track nearly 60 miles a second

Mar 20, 1784 Mirage at Malta —At 1 P M great excitement was aroused in Malta by the sudden appearance of what seemed to be a new island Sailors and fishermen hurried out to take possession of it, but it proved to be the top of Mount Etna, and later the hills and buildings of Sicily became visible The appearance of the mountain top as an island indicates that no rays from such lower parts of the land as were normally visible could reach the observer's eyes, and that the horizon was brought much closer than usual

Mar 21, 1920 Sunspots and Aurora —The date of central meridian passage of an enormous stream of sunspots, visible to the naked eye on this day as a curved streak nearly $\frac{1}{4}$ of the sun's diameter This region of the sun was active for about six months, and in the previous January contained another large stream but slightly inferior in size to that of March The length of these streams was of the order of 150,000 miles, the aggregate area of the component spots being about 2500 millions of square miles On Mar 22–23 a severe magnetic storm occurred, the ranges in declination at Greenwich and Stonyhurst were 86′ and 160′ respectively, whilst the ranges in horizontal force at both observatories exceeded 700γ The accompanying auroral display was the finest seen for many years In parts of Great Britain, objects at several yards' distance could be plainly seen at midnight, and at times even newspaper print could be read At Eskdalemuir, the 'curtain' extended to within 30° of the southern horizon

Mar 22, 1205 End of Long Winter —Although not especially severe, the winter of 1204–5 was very prolonged in north west Europe and England, the greatest cold lasting from the middle of January to Mar 22 It was followed by great mortality among animals in Europe, especially sheep and birds, and this resulted in a famine In England there was great distress, and Stow records that a "quarter of oats [was sold] for forty pence, that were wont to be sold for fourpence Also the money was so sore clipped that there was no remedy but to have it renewed"

SUPPLEMENTARY

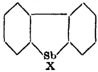
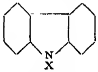
Mar 9-10, 1891 West of England Blizzard —During the passage of a deep barometric depression eastwards along the English Channel, heavy snow fell with high winds over southern England, and especially in the south west According to Mr Bonacina's account in the *Meteorological Magazine* for 1927, in Devon and Cornwall the depth of snow averaged two feet with immense drifts Trains were not only blocked but actually buried in snow, and some of the passengers nearly died of starvation The 'Zulu Express' which left Paddington at 3 P M on Mar 9 did not reach Plymouth until 8 30 P M on Mar 13 The Devonshire lanes remained blocked until the end of March, and it is said that the snow remained on the higher parts of Dartmoor and Exmoor until June There were a number of shipwrecks, especially on the south coast of Devon and Cornwall, in which many lives were lost

Societies and Academies

LONDON

Royal Society, Mar 6 —W J Elford Structure in very permeable collodion gel films and its significance in filtration problems Optical studies have revealed two definite types of structure (i) microgel structure of microscopic order, (ii) ultragel structure of ultra microscopic order Gelation here is a process of phase transition resulting from the coagulating influence of desolvation The nature and stability of the gel is a function of the specific characters of the nitro cellulose and solvent, and the variation in free surface forces around the dispersed phase particles with differing degrees of molecular complexity of the system A complete explanation of the general behaviour of ultra filter membranes is afforded —T W Wormell

Vertical electric currents below thunderstorms and showers This paper describes observations on the discharge of electricity beneath thunderstorms and showers from a raised metal point, 12 3 metres above the ground In the course of a year, the net effect of the point is to discharge about + 0 13 coulombs into the atmosphere The majority of the clouds observed were of positive polarity, that is, mean height of positive charge in cloud was greater than mean height of negative charge In the locality in question, the effective gain of negative electric charge by the earth through the mechanisms of point discharge currents and lightning discharges is at least as large as the sum of the positive charges brought down by the fine weather current and by rain The observations are in agreement with C T R Wilson's hypothesis that downward current in fine weather regions from upper layers of atmosphere to ground is, on the average, balanced by upward current in regions of cumulo nimbus from earth through cloud to upper atmosphere —**G T Morgan** and **G R Davies** Antimony analogues of the carbazole series A description of the anti monial analogues I of the carbazole series II The following structural formulæ represent this analogy, where X is an alkyl or aryl radical

I   II

The starting point in this investigation is commerci ally available diphenyl —**R Fort** and **C N Hinshelwood** The kinetics of the oxidation of gaseous benzene The oxidation of gaseous benzene is a predominantly homogeneous reaction The rate of reaction varies according to a high power of the benzene concentra tion, and a high ratio of benzene to oxygen favours rapid oxidation It appears probable that compara tively short reaction chains are propagated, the variation in the length of which gives rise to the abnormal influence of temperature and pressure on the velocity The chains are propagated more readily when the initial oxygenated product encounters another molecule of hydrocarbon than when oxidised further by oxygen —**A Unmack, D M Murray-Rust,** and **Sir Harold Hartley** The conductivity of thio cyanates in methyl alcohol At 25° C the univalent thiocyanates obey the square root relationship $\Lambda_c = \Lambda_0 - x\sqrt{c}$, and the degree of association is slight, but increases with the atomic number of the metal The divalent thiocyanates fall into two groups those of barium, strontium, calcium, and magnesium, which show considerable association, and zinc and cadmium thiocyanates, which are weak electrolytes —**S J Wright** The elasticity of Pintsch crystals of tungsten The torsional moduli of rigidity of six wires, of which five were single crystals of tungsten of different orient ations, while the remaining one consisted of three crystals, were determined by a dynamical method The results indicated that the variations in elastic properties of tungsten crystals over the whole range of possible orientations would not exceed 1 part in 200 It is concluded that tungsten crystals are isotropic —**Ramakrishna Rao** Study of electro lytic dissociation by the Raman effect (1) The Raman line at 4566 8 A is common to nitric acid and nitrates, it is due to the NO_3 ion, and increases in intensity with increasing dilution of nitric acid The line at 4620 3 A is present only in nitric acid, and corresponds to the undissociated HNO_3 molecule It diminishes rapidly in intensity with increasing dilution, indicating dissociation of nitric acid Varia tion of the degree of dissociation is similar to that found from conductivity measurements but different in order of magnitude

Society of Public Analysts, Feb 5 —**R L Andrew** The determination of minute amounts of iodine in soils and waters A modification of Fellenborg's method has been devised and 60 70 per cent of iodine added to a soil can be recovered The results obtained by colorimetric methods are more trust worthy than those obtained by titration Soils from the North Island of New Zealand contained from 10 to 2100 parts of iodine in 10 millions, and the drink ing waters from 0 004 to 0 120 part per 10 millions —**D W Kent-Jones** and **A J Amos** Preliminary studies in the bacteriology of wheat and flour A satisfactory procedure for enumerating bacteria in wheat and flour has been devised Freshly and normally milled patent flour contains less than 20,000 blood heat bacteria, straight run flour less than 50,000, and lower grade flour up to 300,000 per gm The cool organism content of any grade is nearly always greater than that for blood heat organisms Storage decreases the number of both forms Organisms of the *B mesentericus* group are almost universally present in flour and bread —**H J S Sand** The separation of metals by internal elec trolysis' The metal to be determined is deposited on a platinum cathode, the essential feature of the method being that no electric current is introduced from outside, but, instead, an anode of the baser metal is employed, which is placed in contact with a solution of one of its salts in a compartment separated by a parchment membrane from the solution to be ex amined —**Ella M Collin** The rapid determination of bismuth and copper in lead bullion by internal electrolysis The method has been used to separate small quantities of bismuth and copper from large amounts of lead, the less basic metals being displaced from solution by means of lead, without any external E M F —**G Winthrop Leeper** Notes on the thio cyanate method of determining iron Influence of different classes of phosphates Orthophosphates do not interfere with the thiocyanate reaction provided that the ratio of phosphoric anhydride to iron does not exceed 100 0 02 mgm When extracting the ashed material with acid sufficient time must be allowed for any pyrophosphate formed to be recon verted into orthophosphate Both pyrophosphates and metaphosphates rapidly destroy the colour of ferric thiocyanate

Physical Society, Feb 14 – **W E Summerhays** The diffusion constant of water vapour Water vapour was allowed to diffuse down a vertical tube about 2 in in diameter, a steady concentration gradient being maintained from approximate satura tion at the top to approximate dryness at the bottom The gradient was measured with two katharometers at a definite distance apart and the mass of vapour passing in an observed time was weighed The result is 0 281 cm ^{2}/sec at mean temperature 16 1° C —**M C Johnson** A method of calculating the numerical equation of state for helium below 6° abs, and of estimating the relative importance of gas degeneracy and interatomic forces Gas 'degeneracy' (the effect of non Maxwellian distribution of molecular velocities) is distinguished from gas 'imperfection' (the effect of intermolecular forces) A thermodynamic method is used to calculate the sum of degeneracy and im perfection at 4° and 5° abs for helium —**F D Smith** The magnetostriction constant for alternating mag netic fields A magnetostriction constant K for the Joule effect is defined by the equation $p = KH$ where p is the alternating mechanical stress produced by a

small alternating magnetic field H superposed on a steady magnetic field H_0. It is shown that the alternating intensity of magnetisation I produced by an alternating strain $\delta l/l$ is given by the equation $I = K^{\delta l/l}$, K being the same constant in both equations. These equations are used to calculate the motional impedance of a laminated ring toroidally wound and vibrating in its fundamental radial mode.

DUBLIN

Royal Dublin Society, Jan. 28.—**Henry H. Dixon** and **T. A. Bennet-Clark**: (1) Responses of plant tissues to electric currents. Previous experiments on plant tissues revealed an S shaped relation between response and voltage. This result might be interpreted as due to the response of cells of modal size in the conducting tissue to a certain voltage, each cell responding on the 'all or none' principle; or it might be that the responses of the individual cells vary in magnitude, and that a modal response is given by these cells to a certain voltage. In the present experiments, the staminal hairs of *Tradescantia* consisting of a single filament of cells were used. The same S shaped relation was found. Hence it is evident that the component cells gave responses of different magnitudes according to the voltages applied, and that the 'all or none' principle taking the cells as units is not effective. This result was confirmed on other filiform tissues.—(2) Electrical properties of emulsions. Emulsions of water and olive oil containing both sodium and calcium soaps were prepared so that exceedingly slight increase in the [Na]/[Ca] ratio caused the emulsions to change from the water in oil state to the oil in water state. This change occurred when a sufficient potential difference was applied across the emulsion. The effect was detected most readily by noticing the change in resistance of the emulsions. These were of the order of 10 megohms before the stimulus, and between 1 megohm and 100,000 ohms after. Living protoplasts and water in oil emulsions are apparently the only systems of which the electrical conductivity changes in this manner as a result of the application of an electrical stimulus.—**C. O'Sullivan** and **J. Reilly**: Studies in peat (4). Low temperature carbonisation under various conditions.—**H. A. Cummins**: Experiments on the establishment of rice grass (*Spartina Townsendii*) in the estuary of the Lee.

PARIS

Academy of Sciences, Feb. 3.—**Marcel Brelot**: The equation $\Delta u = cu$, where $c > 0$ admits singular points, and a corresponding Fredholm equation with singular nucleus.—**S. Soboleff**: The analytical solutions of partial differential equations with two independent variables.—**J. S. Lappo-Danilevski**: Observations on the note "Analytical functions of a single variable substitution".—**T. Takéuchi**: The Brownian movement in a field of thermal radiation.—**E. Darmois** and **J. Martin**: The influence of alkaline molybdates on the rotatory power of glucose. Studies of the rotation of glucose solutions in solutions containing sodium hydroxide and molybdenum trioxide as a function of the time. The results suggest the formation of a compound $NaMoO_4,2C_6H_{12}O_6$.—**E. Sevin**: The emission of spectral lines in an electric field.—**R. Deaglio**: The action of light on thermionic phenomena. When the thermionic current is far from saturation, the increase of the thermoelectronic current produced by light on the filament is almost completely a true photoelectric effect.—**Er. Toporescu**: The potentials of metals in pure liquids. From the study of the potential differences shown by a platinum-zinc couple in various alcohols, it was found that there is no parallelism between the potential differences and the dielectric constants of the liquids.—**S. Schlivitch**: The photochemical transformations of photovoltaic batteries.—**F. Bourion** and **E. Rouyer**: Boiling point study of the molecular equilibria of resorcinol in solutions of barium chloride.—**Ballay**: Electrolytic deposits on aluminium and its alloys. For the preliminary treatment of the aluminium or alloy a hot slightly acid solution of ferric chloride is proposed. After this treatment, nickel can be deposited electrolytically as a strongly adherent film.—**R. Cornubert**: The constitution of the so called tetrahydropyronic compounds.—**Max** and **Michel Polonovski**: The passage of a tertiary aminoxide into a dialkylhydroxylamine. N-oxynornarceine.—**Pierre Viennot**: The geology of the Rhune massif (Basses-Pyrénées).—**Cazalas**: The evolution of the vacuome of *Chara* in its relations with the movements of the cytoplasm.—**Mlle. Gabrielle Bonne** and **S. Buchet**: A curious case of floral proliferation in *Rosa alpina*.—**G. Dinulescu**: The presence in France of *Gastrophilus inermis*. The larvæ, obtained from horses suffering from the disease caused by this parasite, were transferred to a suitable medium and growth to the final stage completed outside the animal.—**L. Mercier**: The variation of certain pieces of the male genital sheath of *Pollenia rudis*; the importance of this variation for the idea of species in the higher Myodaria.—**Raymond Hovasse**: A new mode of symbiosis in cochineal insects.—**E. Roubaud**: Evolutionary suspension and obligatory larval hibernation, caused by heat, in the common mosquito, *Culex pipiens*. True diapauses and pseudo diapauses in insects.—**J. Lefèvre** and **A. Auguet**: The influence of the hygrometric state of the air on metabolism. Hypotonus in a moist warm medium. Making use of the calorimetric chamber described in an earlier communication, experiments with sheep proved that for relative humidities less than 85 per cent, the evaporation of the body is not disturbed, but when the humidity exceeds 90 per cent the loss of heat by evaporation falls rapidly and the metabolism is diminished. These results are discussed from the theoretical, hygienic, and practical points of view.—**Pierre Girard** and **J. Parrod**: The formation of hydroxymethyl 4 imidazol, at low temperatures, starting with fructose in a solution of ammoniacal cupric hydroxide. The slow oxidation of lævulose, by shaking with oxygen in ammoniacal copper solution, gave a base, identified through its picrate as hydroxymethyl 4 imidazol.—**A. Paillot**: The cellular and humoral reactions of antimicrobial immunity in the phenomena of symbiosis in *Macrosiphum Jaceæ*.—**Y. Manouélian**: Hereditary syphilis and evolutionary forms of the treponeme.—**J. Alquier, Mlle. L. Asselin, Mme. M. Kogane** and **Mlle. G. Silvestre de Sacy**: The variations of the mineral composition of the bone tissue in the normal rat, rachitic rat, and the rat cured of experimental rickets. The cure of rickets, controlled both clinically and radiologically, does not necessarily imply that the mineral composition of the bone has returned to the normal.

Official Publications Received.

BRITISH

Proceedings of the Royal Society. Series A, Vol. 126, No. A802, February 3. Pp. 365-541. (London: Harrison and Sons, Ltd.) 6s.

Proceedings of the Royal Physical Society for the Promotion of Zoology and other Branches of Natural History. Session 1927-28. Vol. 21, Part 5. Pp. 217-268. (Edinburgh: Oliver and Boyd.)

Ceylon Journal of Science. Section C: Fisheries. Bulletins of the Ceylon Fisheries. Vol. 3: The Pearl Fishery of 1925. By Dr. Joseph Pearson, A. H. Malpas and J. C. Kerkham. Pp. 90+12 plates. (Colombo: Colombo Museum; London: Dulau and Co., Ltd.) 3 rupees.

Survey of India. Map Publication and Office Work, from 1st April 1928 to 31st March 1929. Pp. vii+22+5 maps. (Calcutta.) 1 rupee; 1s. 9d.

Proceedings of the Royal Irish Academy Vol. 39, Section A, No 4 The Brachistochronic Motion of a Dynamical System. By A J McConnell Pp. 31 48. 1s Vol 39, Section B, No 11 The Collembola of Ireland By Herbert Womersley Pp. 160-202 1s 6d. Vol 39 Section B, No 12 The Vegetation of Southern Connemara. By Gertrude Connolly Pp. 203 231 1s Vol 39, Section B, No 13 Mollusca (Pelecypoda, Scaphopoda, Gastropoda, Opisthobranchia) of the Irish Atlantic Slope. By Anne L Massy Pp 232 342 3s 6d. (Dublin Hodges Figgis and Co London Williams and Norgate, Ltd)

The Engineer Directory and Buyers Guide, 1930 Pp 256 (London *The Engineer*)

FOREIGN

Smithsonian Institution United States National Museum Contributions from the United States National Herbarium Vol 26 Part 4 The Piperaceae of Costa Rica. By William Trelease Pp iii+115 226+vii xli (Washington D C Government Printing Office) 20 cents

Bulletin of the Earthquake Research Institute, Tokyo Imperial University Vol 7 Part 3, December 1929 Pp 389-588+plates 32 48 (Tokyo Iwanami Shoten) 2 40 yen

Proceedings of the United States National Museum Vol 76, Art 9 New Lower and Middle Cambrian Crustacea. By Charles E Resser (No 2806) Pp 18+7 plates Vol 76 Art 10 Notes on the Species of Myctophine Fishes represented by Type Specimens in the United States National Museum By Albert Eide Parr (No 2807) Pp 47 Vol 76, Art 19 The Foraminifera of the Ripley Formation on Coon Creek, Tennessee By Willard Berry and Louis Kelley (No 2816) Pp 20+3 plates Vol 76 Art 26 A nearly complete Carapace of a Fossil Turtle *Amyda virginiana* (Clark) By W Gardner Lynn (No 2823) Pp 4+2 plates (Washington D C Government Printing Office)

University of California Publications in American Archaeology and Ethnology Vol 28 No 1 Chumash Prehistory By Ronald L Olson Pp 21 (Berkeley Calif University of California Press London Cambridge University Press) 30 cents

CATALOGUES

The Nickel Bulletin Vol 3, No 2 February Pp 41 72 (London The Mond Nickel Co Ltd)

X Ray News and Clinical Photography No 8 March Pp 12 (London Kodak Ltd.)

Diary of Societies

FRIDAY MARCH 14

BIOCHEMICAL SOCIETY (Annual General Meeting) (in Department of Physiology and Biochemistry, University College), at 3 —R A McCance and K Madders The Comparative Rates of Absorption of Certain Sugars from the Human Intestine —A Hunter and J A. Dauphinee The Rate of Liberation of Arginine in the Tryptic Digestion of Proteins —Prof A Harden and M G Macfarlane Fermentation by Yeast Preparations —G F Marrian and P F Marrian Micro determinations of Hydroxyl Groups by Grignard s Reagent —G F Marrian (a) Further Observations on the Alcohol Isolated from the Urine of Pregnancy (b) An Improved Method for the Preparation of Œstrin The Isolation of Active Crystalline Material from Urine —B Ahmad and Dr J C Drummond Observations on the Relation of Carotene to Vitamin A.—I F Hewitt Oxidation reduction Potentials of Cultures of Hæmolytic Streptococci —C A. Ashford The Phosphorus Distribution in Blood during Hypervitaminosis —R. A Morton, I M Heilbron, and A Thompson Some Further Observations on Vitamin A —R. A. Morton and I M Heilbron A Note on the Vitamin A of Butter —T Moore The Conversion of Carotene to Vitamin A *in vivo* —F Dickens The Preparation and Properties of an Active Principle from the Urine of Pregnancy —K H Coward, K M Key, R. Morgan and F J Dyer Variation in Vitamin A Assay

ROYAL SANITARY INSTITUTE (at Council Chamber, Middlesbrough) at 4 —W S Walton Ventilation of Cinemas, etc —S. E Burgess Flooding from Streams at Middlesbrough

ROYAL ASTRONOMICAL SOCIETY, at 5 —*Papers received* —H C Woods The Use of a Floating Mirror with the Transit Circle —N Goryatscheff Occultations of Stars by the Moon, 1929 —D I Edwards Spectroscopic Parallaxes of B Type Stars (Sixth Paper) the Spectral Types and Parallaxes of 175 Stars —H Mineur Some Remarks concerning the Galactic Rotation —Prof S Chapman On Solar Ultra Violet Radiation as the Cause of Auroræ and Magnetic Storms —P R. Chidambara Aiyar The Relative Variations in the Extents of Bases and in the Heights of Prominences accompanying Variations in their Areas —W M Smart On the Derivation of the Elements of a Visual Binary Orbit by Kowalsky s Method —Royal Observatory, Greenwich Preliminary Values of the Variation of Latitude at Greenwich in 1929 —R. M Petrie On the Calculation of the Relative Temperatures and Pressures existing at the Base of Sun spots.—Prof E A. Milne Preliminary Note on the Structure of Sun spots —Dr W J S. Lockyer Monochromatic Images of the Orion Nebula.—B Lindblad Velocity Ellipsoid, Galactic Rotation, and the Dimensions of the Stellar System —J G Hagen On W Herschel s Nebulosity V 34=N G C 1990 —M A. Blagg Discussion of Observations on Three Long Period Variables made by A. N Brown No. 2, V Cassiopeiæ, 1909-1929 January

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (at Guy s Hospital), at 5.—Clinical Meeting

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Sir Frank Colyer Demonstration of John Hunter s Specimens of the Teeth.

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5 —J Harvey A Harmonic Analyser —R A. Faraday A Method of Comparing Small Magnetic Susceptibilities —Dr H. T Flint The Masses of the Proton and Electron —Dr Ezer Griffiths Exhibition of Lantern Slides in Connexion with his Recent Visit to New Zealand.

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 5 30.—J J O Neal Deep Well Pumps.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6 —A. S Kennard A E. Salisbury and B B Woodward On the Types of Lamarck s Genera of Shells selected by J G Children, with Notes.

TOWN PLANNING INSTITUTE (at Caxton Hall), at 6 —Capt. B S Townroe Town Planning and the Man in the Street.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (Annual Business Meeting), at 6 45

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7 —Exhibition of Industrial Kinematograph Films

MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers Club Manchester), at 7 15 —H C Armitage Machine Tools from the Manufacturing Users Point of View

NEW EDUCATION FELLOWSHIP (at Livingstone Hall, S W 1), at 7 30 —G H Widdows Open Air Schools for all

JUNIOR INSTITUTION OF ENGINEERS, at 7 30 —W A. Sallis An outline of Siemens No 50 Telephone Switching equipment

INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University), at 7 30 —A G Lobley Electric Heat Treatment Furnaces

OIL AND COLOUR CHEMISTS ASSOCIATION (at 30 Russell Square) at 7 30 —The Protection of ironwork on Buildings

OIL AND COLOUR CHEMISTS ASSOCIATION (Manchester Section) (at Milton Hall Manchester) at 7 30 —Members Evening

ROYAL INSTITUTION OF GREAT BRITAIN at 9 —Prof G Elliot Smith New Light on Vision

INSTITUTE OF RUBBER TECHNOLOGISTS (at Manchester Café, Ltd , Manchester) —G F Thomson Colours used in the Rubber Industry

SATURDAY MARCH 15

PHYSIOLOGICAL SOCIETY (Annual General Meeting) (in Department of Physiology and Biochemistry University College) at 3 —Prof A V Hill The State of Water in Muscle —M G Eggleton and P Eggleton The Creatine Content of Resting and Fatigued Sartorius Muscles of the Frog —O Meyerhof and F Lipmann Change of pH during Activity of Muscle —F J W Roughton The Rate of Penetration of Oxygen into the Red Blood Corpuscle —H E Magee and E Reid Diffusion of Phosphates through Surviving Intestine —Margaret Hill and Dr A. S Parkes (a) Ovulation induced in the Hypophysectomised Rabbit by Anterior Lobe Extracts (b) Effects of Anterior Pituitary Preparations on the Anœstrous Ferret —J H Burn and H W Ling Ketonuria on Fat Diet (a) after Injections of Pituitary (Anterior Lobe) Extract (b) during Pregnancy —H P Gilding The Relation of the Central Nervous System to a Local Cutaneous Ischæmia in Animals —Dr F R Winton The Effects of Increases of Ureter and Venous Pressures on the Composition of the Urine —Ruth Verney The Osmotic Pressure of Plasma Proteins in the Presence of Caffeine —Marion O P Wiltshire The Effect of Amino Acids on the Rate of Oxidation of Adrenaline —R. Granit Interaction between Distant Areas in the Human Eye —Demonstrations —Prof A V Hill The Measurement of the Depression of Vapour Pressure in an Aqueous Solution —W Hartree (a) Rapid Sensitive Muscle Thermopiles (b) Records showing Relaxation Heat - Dr A S Parkes and Margaret Hill Experiments on the Relation between the Anterior Pituitary Body and the Gonads —Dr D T Harris A Photoelectric Colorimeter —H P Gilding A Method for Demonstrating the Localised Distribution of Vasoconstrictor Nerves —R T Grant Arterio venous Anastomoses in the Rabbit s Ear —F R Miller A Decerebration Clamp.—W A. M Smart C G Wilson and F Campbell Smith A Photoelectric Hæmoglobinometer —J H Shaxby Simple Methods of Demonstrating Visual Adaptation —Dr E D Adrian and B H C Matthews Apparatus for Demonstrating Action Current Records —E W H Ellis (a) Electric Recording Drum (b) Spiral Recording Drum, (c) Improved Gas Smoking Burner (d) Syringe Signal —Mary Pickford and Dr E B Verney Exteriorised Ureters in the Dog —Dr F R. Winton Methods and Models for the Analysis of Tonus in Unstriated Muscle —L E Bayliss and the late A. R. Fee (a) An Automatic Pump Control and Flow Recorder (b) The Rein 'Thermo-Stromuhr —P Eggleton Micro-chemical Apparatus for Lactic Acid and Nitrogen Determination —A. V Horton and P Eggleton An Isometric Lever

ROYAL INSTITUTION OF GREAT BRITAIN at 3 —Sir Ernest Rutherford Atomic Nuclei and their Structure (2).

ROYAL IRISH ACADEMY (Dublin).

MONDAY, MARCH 17

ROYAL SOCIETY, EDINBURGH, at 4 30.—F Walker The Doleritic Isles of the North Minch —W J McCallien and R. B Anderson The Carboniferous Sediments of Kintyre —W J McCallien A Contribution to the Geology of North Eastern Antrim being an Introduction to the Correlation of the Dalradian Rocks of Scotland and Ireland —Lt.-Col L M Davies The Genus *Dictyoconus* and its Allies A Review of the Group, together with a Description of Three New Species from the Lower Eocene Beds of Northern Baluchistan —D F Martyn On a New Method of Measurement of Minute Alternating Currents

VICTORIA INSTITUTE (at Central Buildings Westminster), at 4 30 —Rev C Gardner How far do the Apologetics of Bacon, Butler and Paley hold good for Present Use?

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —C E Shattock Demonstration of Diverticula.

KING S COLLEGE ENGINEERING SOCIETY, at 5 15.—W H. Dormer Haulage in Coal Mines

BEDSON CLUB (at Armstrong College, Newcastle-upon Tyne), at 6.30 —Dr E K Rideal Some New Properties of Unimolecular Films (Bedson Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7 —A. F Harmer and others Discussion on High Tension Substation Control Gear

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London), at 7 —W Taylor Science in Works Management (Lecture).

INSTITUTION OF AUTOMOBILE ENGINEERS (Glasgow Centre) (at Royal Technical College, Glasgow), at 7.30.—H. R. Ricardo: Combustion in Diesel Engines.
BRADFORD TEXTILE SOCIETY (at Midland Hotel, Bradford), at 7.30.—J. H. C. Hodgson: International Co-operation in the Textile Trade.
HUDDERSFIELD TEXTILE SOCIETY (at Huddersfield Technical College), at 7.30.—G. R. Carter: The Peculiar Economics of the Textile Industry.
ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.30.
ROYAL AERONAUTICAL SOCIETY (Halton Branch).—Metal Construction of Aircraft.

TUESDAY, MARCH 18.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. H. Hunter: The Significance to Clinical Medicine of Studies in Calcium and Phosphorus Metabolism (Goulstonian Lecture).
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. C. Singer: The Passage from Mediæval to Modern Science (2): The Science of the Renaissance.
MINERALOGICAL SOCIETY, at 5.30.—Prof. W. L. Bragg: The Structure of Silicates (Lecture).
ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.
ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Col. A. E. Hamerton: Report on the Deaths occurring in the Society's Gardens during the Year 1929.—Dr. H. F. Barnes: On some Factors Governing the Emergence of Gall Midges (Cecidomyidæ: Diptera).—G. Dollman: On Mammals obtained by Mr. Shaw Mayer in New Guinea and presented to the British Museum by Mr. J. Spedan Lewis.—G. E. Hutchinson: Report on *Notonectidæ*, *Pleidæ* and *Corixidæ* (Hemiptera Heteroptera) collected during Mr. Omer Cooper's Expedition to Abyssinia.—A. Stanley Hirst: On some Australian Acari (Trombidiidæ, Anystidæ, and Gamasidæ).
INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—D. J. Watkins: Electric Locomotives.
LONDON NATURAL HISTORY SOCIETY (at Winchester House, E.C.), at 6.30.—Dr. A. Thomson: The Pecten of the Bird's Eye.
TELEVISION SOCIETY (Annual General Meeting) (at University College), at 6.30.—Sir Ambrose Fleming: The Relation of Governments to Invention (Presidential Address).
INSTITUTION OF ELECTRICAL ENGINEERS (North Western Centre) (at Engineers' Club, Manchester), at 7.—H. W. Taylor: Voltage Control of Large Alternators.
ILLUMINATING ENGINEERING SOCIETY, at 7.—The Lighting of a Large Liner.
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members and Graduates Section—Manchester and District Branch) (at Milton Hall, Manchester), at 7.
INSTITUTE OF METALS (Birmingham Local Section) (at Chamber of Commerce, Birmingham), at 7.—W. R. Barclay: Nickel Chromium Alloys.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Kinematograph Group—Annual General Meeting), at 7.—A. Kossowsky: Modern Methods of Sound Reproduction in Kinematography.
INSTITUTION OF AUTOMOBILE ENGINEERS (Wolverhampton Centre) (at Engineering and Scientific Club, Wolverhampton), at 7.30.—Capt. J. S. Irving: Problems Encountered in the Design of the *Golden Arrow*.
INSTITUTE OF METALS (North East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—Annual General Meeting.
INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Society of Chemical Industry—Edinburgh and East of Scotland Section) (at 36 York Place, Edinburgh), at 8.—Prof. S. A. Smith: Poisoning and Disease in Industry.
ROYAL SOCIETY OF MEDICINE (Pathology Section), at 8.—Annual General Meeting.

WEDNESDAY, MARCH 19.

SOCIETY OF GLASS TECHNOLOGY (at Talbot Hotel, Stourbridge), at 2.—G. V. Evers: Notes on the Manufacture of Refractory Materials in America.—Dr. J. H. Partridge and H. C. Biggs: Glasshouse Refractories. A Study of Corrosion Resisting Properties.—F. C. Gough: Some Practical Results with Sillimanite for Glasshouse Refractories.
ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.
OVERHEAD LINES ASSOCIATION (at Institution of Electrical Engineers), at 5.30.—Dr. Eckstrom: Comparative Costs of Overhead and Underground Transmission Lines.
INSTITUTION OF AUTOMOBILE ENGINEERS (Leeds Centre) (at Metropole Hotel, Leeds), at 7.15.—W. J. Morgan: Organisation of Public Service Motor Vehicle Repair and Maintenance Systems.
INSTITUTION OF LOCOMOTIVE ENGINEERS (Birmingham Centre) (at Chamber of Commerce, Birmingham), at 7.15.—W. Kay: Mineral Oils and Lubrication.
SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section) (at University College, Nottingham), at 7.30.—Dr. H. Levinstein: Some Derivatives of Cellulose and their Industrial Application (Lecture).
ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Dr. H. Lapworth: Meteorology and Water Supply (G. J. Symons Memorial Lecture).
ROYAL SOCIETY OF ARTS, at 8.—Mrs. Arundell Esdaile: The Portrait in Later Monumental Sculpture.
FOLK-LORE SOCIETY (at University College), at 8.—Mrs. R. Aitken: Saint Dominic of the Road and the Cock that crowed in the Dish.
ST. PAUL'S ECCLESIOLOGICAL SOCIETY (Annual Meeting) (at Royal Institute of British Architects), at 8.—At 8.30.—H. W. Fincham: Ely.
ROYAL MICROSCOPICAL SOCIETY, at 8.—J. E. Barnard: Resolution and Visibility in Medical Microscopy (postponed Presidential Address).
ROYAL AERONAUTICAL SOCIETY (Yeovil Branch).—Major C. J. Stewart: High Altitude Equipment for Aircraft.
ROYAL AERONAUTICAL SOCIETY (Coventry Branch).—Wing-Comdr. T. R. Cave-Browne-Cave: The New Airships Machinery.
INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre).

THURSDAY, MARCH 20.

ROYAL SOCIETY, at 4.30.—Discussion on Catalytic Reactions at High Pressures, to be opened by Prof. G. T. Morgan, followed probably by M. P. Applebey, Prof. W. A. Bone, Prof. H. B. Dixon, Prof. F. G. Donnan, Dr. F. A. Freeth, S. J. Green, C. N. Hinshelwood, E. J. Lush, Col. Pollitt, Dr. E. K. Rideal, Dr. R. E. Slade, and Prof. R. V. Wheeler.
LINNEAN SOCIETY, at 5.—Dr. C. Tate Regan: A Ceratioid Fish (*Caulophryne polynema*, sp. n.), Female with Male, from off Madeira.—Lt.-Col. J. Stephenson: An Oligochæte Worm Parasitic in Frogs of the Genus *Phrynomerus*.—Capt. F. Kingdon Ward: Mishmi Hills and Assam.
ROYAL SOCIETY OF MEDICINE (Dermatology and Medicine Sections), at 5.—Discussion on The Therapeutic Value of Gold Compounds, Sanocrysin, etc.
KING'S COLLEGE ENGINEERING SOCIETY, at 5.15.—S. B. Thomas: Motoring: Its Progress in the Last Thirty Years.
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—J. B. S. Haldane: Some Problems of Genetics.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Dr. B. Leggett: The Medical and Surgical Applications of Electricity.
SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (Annual Meeting) (at Chamber of Commerce, Birmingham), at 6.30.—At 7.—Dr. W. R. Ormandy: A Wood Distillation Factory in Jugo Slavia.
INSTITUTION OF ELECTRICAL ENGINEERS (Hampshire Sub-Centre) (at University College, Southampton), at 7.
INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College, Dublin), at 7.45.—W. J. Girvan: The Practical Application of the Principles underlying the Equitable and Profitable Sale of Electrical Energy.
CHEMICAL SOCIETY, at 8.—Prof. C. K. Ingold: The Mechanism of and Constitutional Factors Controlling the Hydrolysis of Carboxylic Esters. Part I. The Constitutional Significance of Hydrolytic Stability Maxima.—Miss C. M. Groocock, Prof. C. K. Ingold, and A. Jackson: The Mechanism of and Constitutional Factors Controlling the Hydrolysis of Carboxylic Esters. Part II. Hydrolytic Stability Maxima of some Glyceric Esters.
ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (Laboratory Meeting) (at Royal Army Medical College, Millbank), at 8.15.—Demonstrations by Dr. S. Adler, Sir Aldo Castellani, Col. A. C. H. Gray, Dr. C. A. Hoare, Lt.-Col. S. P. James, Dr. W. James, C. MacHattie and Major C. R. Chadwick, J. F. Marshall.
BRITISH INSTITUTE OF RADIOLOGY, at 8.30.

FRIDAY, MARCH 21.

BRITISH INSTITUTE OF RADIOLOGY, at 5.—Discussion on Radiology in Chest Diseases.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Frank Colyer: Demonstration of Specimens illustrating Dento-alveolar Abscess and Dental Cyst.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.—W. Nithsdale: The Design and Results of a 600 lb. per sq. in. Boiler Installation.
NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—Sir Westcott Abell: Direct Flooding Calculations.
INSTITUTE OF MARINE ENGINEERS, at 6.30.—Annual General Meeting.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7.
INSTITUTION OF ELECTRICAL ENGINEERS (North Eastern Students Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.15.—J. Bennett and O. A. Chrisp: A Survey of Switch and Control Arrangements with Examples of Modern Practice.
JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—M. V. Hurst: Surface Combustion.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Seton Gordon: Sea Birds and Seals.
SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester).—Short Papers.

SATURDAY, MARCH 22.

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College), at 3.—C. L. Beaven and others: Discussion: Are we satisfied with the Present Syllabus in Mathematics for the General School Certificate?
ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: Atomic Nuclei and their Structure.

PUBLIC LECTURES.

SATURDAY, MARCH 15.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. N. Milligan: Monsters of the Deep.

MONDAY, MARCH 17.

LONDON SCHOOL OF ECONOMICS, at 5.—Prof. E. Lederer: Social Development in Germany during the last Ten Years. (Succeeding Lectures on Mar. 19 and 20.)
UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5.—Prof. E. B. Verney: The Reserve Forces of the Kidney (Sydney Ringer Memorial Lecture).
UNIVERSITY OF LEEDS, at 8.—Prof. P. N. Miliukov: The Past in the Present in Russia.

WEDNESDAY, MARCH 19.

KING'S COLLEGE, at 5.30.—Prof. J. Maritain: Science et Philosophie d'après les Principes du Réalisme Critique.

THURSDAY, MARCH 20.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Dr. Margaret Fishenden: The Outlook for Smokeless Heating (Chadwick Lecture).

SATURDAY, MARCH 22.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—M. A. Phillips: Pond Life.

SATURDAY, MARCH 22, 1930

CONTENTS.

Progressive Physics

THE conception of segregation and integration put forward by Herbert Spencer in his "First Principles" seems to be illustrated by changes in the character of the correspondence columns of NATURE in recent years During the War, and even before, few communications to these columns were published from scientific workers outside Great Britain, the process of segregation tended to collect them around separate geographical centres Since then, however, the international outlook of science has begun to reassert itself, and investigators everywhere desire to make their methods or results as widely known as possible Early publication serves a useful purpose, not only as a preliminary announcement of work to be described more fully later in a special journal or before a scientific society, but may also save other investigators from devoting time to a piece of research work which is being carried on elsewhere

This function of the correspondence columns of NATURE has become increasingly important since what Prof Smithells has called 'electronomy' became a branch of physical science, and stimulated active work in a wide and fertile field of mathematical and experimental inquiry At the present time, more attention is devoted to explorations of this field than to any other scientific region, and this activity is reflected in our correspondence columns as it is in the *Proceedings of the Royal Society* NATURE is, however, an international journal of science, and communications for publication as 'Letters to the Editor' come from many countries

An accumulation of such correspondence is relieved to a slight extent this week by the publication of a Supplement containing a number of letters on atomic physics and related subjects The variety and intricacy of the subjects dealt with in these letters illustrate most forcibly the difficulty inevitably encountered by any physicist who attempts to keep himself familiar with even the barest outlines of work being carried on outside his own special branches, and *pari passu*, the problem in selection of material which confronts teachers of the more advanced portions of the subject

The value of the critical accounts of current research which appear from time to time in the *Physikalische Zeitschrift*, the new *Physical Review Supplement*, and other journals, and in the small monographs now being published in Great Britain as well as in Germany and France, cannot be overstated, whilst Prof Sommerfeld's 'Wellen mechanischer Erganzungsband", probably in as wide use as his classical "Atombau and Spektrallinien", offers the wave mechanics as a useful

tool and mode of expression of results to those whose interests are primarily experimental At the same time, the theoretical equipment which is essential for a full appreciation of the implications of the new mechanics is so heavy that the active co-operation of a trained mathematician is as necessary in much laboratory work as the services of a glass-blower and mechanic

There is at least one important branch which does not happen to be represented in the supplement, namely, that concerned with the line spectra of atoms Hund's theory of spectra, which permits of the prediction of the exact types of spectral terms that will result from any configuration of the electrons of an atom, has already led to such great advances in the analysis of complicated spectra that the analysis of *all* line spectra now appears to be only a question of time There are still notable gaps, particularly in connexion with extreme ultra violet spectra and the spectra of the rare earths, but these no longer offer the seemingly insuperable barriers they once presented It must be remembered, too, that Hund's theory correlates the terms of spectra with the discrete energy states of the atoms in far more detail than in the parent theories of Bohr and Sommerfeld, so that, for example, H N Russell's analysis of the arc spectrum of titanium is in effect a statement of the individual energies of hundreds of known configurations of neutral titanium atoms, and gives these energies with the high precision of spectroscopy

This subject still offers a wide field for experimental research, as does the problem of the intensities of lines, of particular importance in astrophysics in view of the wealth of material offered by stellar spectra The origin of the lines of the coronal spectrum of the sun has still, however, to be established, and the 'forbidden' lines of oxygen, nitrogen, and iron found in some stars and nebulæ have still to be produced in the laboratory

Band spectra continue to attract much attention, and here again Prof Hund has been largely instrumental in placing the theory of molecules on a sound basis The fortunate fact that Raman spectra can be obtained without extraordinary difficulty is also leading to the accumulation of much valuable information about the properties of molecules—there are no less than five communications on this subject in our Supplement, and it is perhaps not looking too far ahead to envisage a time when an enumeration of the infra red frequencies of a new compound will be regarded as necessary to its description as melting-point and crystal structure

The extent to which experimental research has been fostered during the last decade by the large commercial laboratories, in particular by those interested in the production of lamps and wireless apparatus, has still perhaps to be appreciated fully Quite apart from the work done directly by these bodies, which includes such important contributions to pure science as Davisson and Germer's work on the diffraction of electron waves and Langmuir's investigations of the properties of highly ionised gases, a high standard for manipulation has been created, the necessity for which arises from such facts as the making or marring of the electron-emitting properties of a filament by a layer of impurity on the surface one atom thick The widespread use of diffusion pumps, the less general, but highly desirable use of induction furnaces for degassing metals *in vacuo*, and the introduction of new types of glass for containing vessels have come largely from their example and pioneer work

In one respect, however, the activities of the commercial laboratories and other non-academic establishments are a little disquieting As Prof Andrade has pointed out, twenty-five or thirty years ago the young man who wanted to devote his life to experiment turned automatically to the universities, now, if he wants to earn a living, he turns, almost automatically, away from them (*Journal of Scientific Instruments*, February 1930, p 49) It is highly probable that the universities will nevertheless continue to be the home of theoretical physics, and it may be questioned if this partial divorce of the two main branches of the subject will be for the ultimate good of either

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Problems of Plant Physiology

Growth and Tropic Movements of Plants By Sir Jagadis Chunder Bose Pp xxix + 447 (London, New York and Toronto Longmans, Green and Co, Ltd, 1929) 21*s* net

ON examining the prolific publications of Sir Jagadis Chunder Bose, concerning various plant physiological phenomena, one is inevitably impressed by the unique style which he adopts in attacking the various problems with which he has dealt His methods are often stupendous in their departure from orthodoxy (for which, maybe, he is to be congratulated), in experimental accuracy, and in the forethought for possible experimental error His results, too, have often astounded many of his contemporary workers, but their value, unfortunately, is too often uncertain, through his being rather precipitate in drawing his conclusions

Such a generalised opinion of his works is scarcely changed by this publication, "Growth and Tropic Movements of Plants", his latest work Yet, whatever one may feel about the value of the bulk of this author's work from a purely physiological point of view, one must admit its value in other ways There probably are very few plant physio-

logists who have attacked so many controversial problems in such an original manner This, at any rate, stimulates thought and criticism in others, which is all to the common good Such may be said of nearly all Bose's work, and especially of his well-known exploits into the mysteries of plant responses and the ascent of sap in plants

In this new series of investigations, Bose has certainly maintained his reputation as an original worker along unusual lines His methods are exclusively his own, and in an admirable fashion does he go on, not from where a previous worker left off, but in a manner peculiar to himself In this work on growth and tropisms, the experimental method is, in general, brilliant if not for its accuracy, then for its originality But these phenomena, like all others, demand an ultimate exposition of the truth This can never be cloaked, as an ideal, however enthusiastic one might become over a certain theory One feels, therefore, to do this, we should strive for it in as simple a way as possible Simplicity, so far as it can be indulged, is always the more desirable, so long as it maintains a practicably natural state of affairs, and this is possibly where Bose still remains at fault, for his experimental methods are usually far too complex in construction

In striving to give weight to his convictions, Bose—broad-minded as he is in his outlook on science (the science of the universe, as he calls it elsewhere)—misses the mark very badly in his unfortunate exclusiveness where the work of others is concerned Correlation of results of different workers is not only helpful to the student, but also is it essential, if such results are to carry any degree of conviction This exclusive attitude of Bose, this failure to emphasise contrasts and comparisons with the work of others, has been exemplified so often as sometimes to prove exasperating, and such aloofness is demonstrated here again

The majority of the methods involved in this new series of investigations are similar to the previous ones adopted by the author, in that the plant is made to record its own autograph Yet one or two are worthy of special note

Several new methods are described for the measurement of growth in plants The author's criticism against the orthodox type of instrument, the auxanometer, is that an undesirable length of time is necessary before any appreciable result can be obtained The auxanometer, in any case, is of little use, except for demonstration purposes, and such criticism is so clear as to be unnecessary However, the new apparatus is undoubtedly much more desirable than the auxanometer

Bose's high magnification creseograph is a splendid piece of apparatus which obviates many of the usual errors In it is used the optical lever, which the author introduced into experimental physiology several years ago Much experimental error, such as tension due to levers, stretching of connexions and friction at the fulcrum, has been ingeniously eliminated

This creseograph is claimed to be highly sensitive, measuring a very small increase in growth, over an exceptionally small period of time To quote an actual statement, Bose claims that this apparatus permits the record of growth elongation of 0 00005 mm and a difference can be seen over an interval of 0·05 second This is indeed sensitive as compared with methods which have been previously at the disposal of the plant physiologist

In his studies of growth phenomena, Bose still maintains his conception of rhythmic pulsations in life processes This is exemplified in his statement that growth is a pulsatory movement, being the resultant difference in each pulsation between elongation and recovery This suggestion is a very plausible one, no doubt, but the experimental evidence obtained by the investigator appears to be considerably lacking in conviction

Two other methods of measuring growth are described in the book One is termed the "Method of Falling Weight", and the other the "Method of the Inclined Plane" Neither, however, seems to be so sensitive as the optical lever creseograph In all three cases, the author takes change in linear dimension as an expression of growth This, of course, cannot be accepted without reservation, yet, in spite of this and other drawbacks, the methods (and especially the first) might be used with advantage in any plant physiology laboratory, if only for demonstration purposes

Many studies on the effect of conditioning factors of growth are described These, however, have produced few observations of paramount importance, and, on the whole, the results are rather disappointing In these investigations, too, Bose betrays a definite determination to introduce new methods, to the exclusion of other already established ones, which may be better This is clearly emphasised in his experiments on the effect of temperature, although his own method is perhaps better, for obtaining gradual changes in temperature Otherwise, a gas or electric thermostat would perhaps meet the case much more efficiently

In all this work on growth, surprisingly little has been brought forward of any value from the point of view of newness or possible revolution of ideas

that, we would naturally look for, since our knowledge of growth phenomena is so deplorably inadequate at present The first section of the book, therefore, apart from one or two methods which are decidedly well worthy of note, is disappointing

In the second part of his book, Bose has attacked the problems involved in plant tropisms Here his investigations begin with the assumption that he is out to prove that the average physiologist is quite wrong in his conception of the various mechanisms involved in tropistic curvatures Despite the many theories put forward, the average thinker is quite prepared to admit that we know practically nothing of this section on plant life processes Bose's reference to the generalisation that shoots are positively phototropic and roots are negatively phototropic, as being "hasty", is quite unnecessary and ill founded, since this generalisation has been rejected for some time now

Bose's methods of attacking these problems are very similar to the previous ones, and again, some might well be applied to demonstration experiments, although the author emphasises again their extreme sensitiveness No new facts have been exposed, except perhaps that in all probability (although Bose states it dogmatically) the latent period may be much shorter than has been hitherto supposed This is interesting and leads one to suggest that possibly, when a still more sensitive recorder has been devised, it may be established that no appreciably latent period really exists

In his investigations on geotropism, carried on along similar lines, the author states that it is unnecessary to assume that geotropic reaction is really different in the root from that in the shoot Although many theories, concerning either one or the other or both, have been put forward by various workers, nothing has been genuinely accepted, and this assumption certainly has not His use of the term 'stimulus' and so forth involves a definite meaning for them, just as definite, so he states, as such terms in animal physiology This is only natural, of course, in view of his conception of a plant nervous system, but even now, in spite of his observations, it seems doubtful whether plant physiologists are justified in accepting these terms

Concerning the geoperceptive region, Bose makes some observations which, reactionary though they may be, might prove of considerable interest By means of an electric probe (which we have met before in this author's works), he has attempted to show (and has himself concluded) that such a region exists as a cylindrical layer, some distance below the surface of the organ This layer, one assumes from his statements, is not absolute, since it apparently merges insensibly, with declining excitability, from a maximum to a minimum nearer the surface and a minimum nearer the centre Such an observation may prove of value, but one cannot help suspecting that the methods used and the results so far obtained make the whole conception very questionable at the moment

All irritabilities, according to Bose, should not be considered as separate phenomena, but rather as variants of a common one This observation only voices the suspicions of many plant physiologists It therefore is of little value, and especially since the experimental evidence brought out is insufficient to warrant this assumption, although it certainly does not tend in any other direction

The evidence, on the whole, in the latter half of the book is meagre and lacking in conviction Much has been done which is of great interest from an experimental point of view, but little new is there to evince any theoretical considerations In fact, one might almost say that Bose could, with just as much confidence, have postulated his theories of tropisms from the few facts that have already been established by previous authors, with simpler methods

The whole book may be described as a practical note book—one written by a student with endless originality, perseverance, conception of method, and amazingly delicate technique, but also with a tendency to misconstrue results and form precipitate conclusions Nothing really new has been added to our very scanty store of knowledge of these subjects—a little more detail perhaps—and much has been done which one feels might just as well have been left undone, at any rate, for the time being We really know so little about natural phenomena and natural conditions, that to examine the effect of unnatural or artificial ones, as Bose all too frequently has done here, seems almost sacrilege, at the moment

One might say that, instead of being content with a toy of simple proportions, Sir Jagadis has assembled one of more complicated parts and enormous dimensions Thus, with enthusiasm has he spent much time with his ingenious contrivance and made it do all manner of wonderful things (perhaps with more exactitude than the simpler one, and, if so, this is desirable), but it has done nothing new, and, in such cases, there is always the risk of missing the wood for the trees, or, worse still, finding the wrong wood Much more desirable would it be to get a greater mass of trustworthy facts and, coupling them with those obtained by

other workers, make more possible deductions, rather than to set out to impress an idea at all costs, which, after all, may be wrong

Until this is done (and one feels that we have *not* been helped to any appreciable extent by this latest work), we must perforce remain in the morass of scientific hypothesis, which is decidedly unsound where tropisms are concerned, until such time as we obtain the evidence necessary to our attaining a more substantial conception of the actual truth

L J F BRIMBLE

Science in the Fifteenth Century.

Science and Thought in the Fifteenth Century, Studies in the History of Medicine and Surgery, Natural and Mathematical Science, Philosophy and Politics By Lynn Thorndike Pp xiv + 387 + 10 plates (New York Columbia University Press, London Oxford University Press, 1929) 24*s* net

IT is most satisfactory to be able to record that the last few years have been marked by an ever increasing output of literature dealing with the early history of the natural sciences, and the excellent advice of the Hebrew poet,

"Let us now praise famous men",

has been taken by many, who have thereby followed the good example of NATURE, which for several years past has made references from time to time to the achievements of bygone scientific worthies In spite of absence of manuscripts and other first hand documents in the United States, the same ends are being pursued by our friends across the water, and by none with greater enthusiasm than by Prof Lynn Thorndike of Columbia University His most recent book comprises a series of studies chosen to illustrate the thought and science of the fifteenth century, a period which is less well known than the earlier, and perhaps more fruitful, period of Roger Bacon, but which is also well worthy of investigation

To place the subject in its proper light and atmosphere, the main characteristics of fourteenth century science are outlined in a useful introductory chapter, which is calculated to astonish even those mechanical creatures of habit who, having "stopped thinking and reading twenty years ago", repeat "old slurs and disparaging generalisations at the expense of the middle ages" Our author quotes many examples of the high culture and advanced thinking of scholars of the twelfth, thirteenth, and fourteenth centuries, such as Occam, Buridon, Albert of Saxony, and also Nicolas Oresme, whose ideas concerning physics and astronomy were remarkable By 1326, Richard of Wallingford, father of trigonometry, had brought measuring instruments and clocks to a marvellous state of perfection Gunpowder, the blast furnace, the mariner's compass, and many other inventions, were all available for useful purposes even so elaborate a surgical operation as rhinoplasty had been successfully accomplished

The status of medical practitioners in the fifteenth century is illustrated by early Italian disputations as to the relative importance of medicine and law, in which it is argued that the lawyers have attained to a higher social position than the doctors, because they do not soil themselves by plunging their hands into viscera, and so on Is this, perhaps, the reason why the Royal Society includes so few surgeons among its fellows even at the present day? But it may be that the science of medicine is still, as John of Arezzo suggested, "under the rule of Mars and Scorpion invidious, malevolent, plotting against and hating all others" Then appropriately follow chapters dealing with the surgery of Leonard of Bertipaglia, an anonymous "Practica Cirurgie" assigned to John Braccia of Milan, or to Peter of Tossignano who used to prescribe caustic water, and lastly, an autopsy by Bernard Tornius, of which both the original text and a translation are printed Among minor medical writings, one by John of Arezzo on poisonous mushrooms, their appearance, black, livid, or green when cut open, their being rendered harmless when cooked with wild pears, and the symptoms of poisoning, and its cure by vomiting, have a perennial interest

In dealing with Nicholas of Cusa, Prof Thorndike strikes a more controversial note, and points out that, at least so far as the astronomical system with which the name of Cusa is associated is concerned, it is probable that exaggerated praise has been meted out to him For, so far from being an important precursor of Copernicus, Cusa scarcely carried his system beyond that of Ptolemy All he appears to have said is that the earth has a movement, and its position varies a little in consequence The work of Cusa's protégé, George von Peurbach, the Virgilian scholar and inventor of the geometer's quadrate, is next discussed He is remembered as the translator of six books of the Almagest, but unfortunately his version, having been made *breviorem lucidioremque* than the original Greek, is a poor substitute for it His reputation, like that of Regiomontanus, has "received rather undue emphasis from modern German historical scholarship, whereas until recent years the English, French, Italian, and Spanish

mathematicians of the fourteenth and fifteenth centuries have been less studied and written about"

The French arithmetic of Jehan Adam composed in 1475 concludes this section of the book The remainder deals with treatises on politics, moral philosophy, and other matters, but many readers will take pleasure in being introduced to the " De Constitutione mundi ", by John Michael Albert of Carrara, the probable sources of whose information are carefully traced by the author

We owe a debt of gratitude to Prof Thorndike and to the Dunning Fund for this volume of miscellaneous studies now presented to us

Greenland

Greenland Published by the Commission for the Direction of the Geological and Geographical Investigations in Greenland Editors Prof M Vahl, Vice Admiral G C Amdrup, Dr L Bobé, Prof Ad S Jensen (Published at the Expense of the Carlsberg Fund) Vol 2 *The Past and Present Population of Greenland* Pp iv + 415 (Copenhagen C A Reitzel, London Oxford University Press, 1928) 35s net

THE first volume of " Greenland " was reviewed in NATURE of Mar 23, 1929 This, the second of the three volumes planned, deals exclusively with the past and present inhabitants Of the six articles, three are concerned with Eskimo ethnology and archæology, and three with the now extinct tenth century colonisation by Norsemen

Dr Birket Smith provides a full and interesting account of the present day Greenlanders, their distribution, mode of life, and material culture A contrast is made between the high-arctic type at Etah (Sir John Ross's Arctic Highlanders) and the subarctic kayak-using people farther south The former can still be named Eskimo, the latter are Greenlanders, half Eskimo, half European They appear to have none of the disadvantages so often implied by the term ' half breed ', but on the other hand, with usages and habits modified by Danish influence, it can even be claimed that Greenlanders are in many ways superior to unmixed Eskimo stock Their number at the present time is about 14,000, compared with 6000 at the beginning of last century Dr Birket Smith's description is the only full and accurate account of these people written since the publication of Dr Rink's " Danish Greenland " in 1877

Shorter articles deal with intellectual culture, and with Eskimo archæology The latter, though brief, is fairly exhaustive, little excavation having as yet been undertaken The nature of the older (Thule) culture is explained Eskimo origins and the lines of immigration are discussed, from this it appears that the balance of evidence now is in favour of the view that north east Greenland was peopled by way of the north, and that the track of the immigrants lay so far north as lat 83° N

The first of the articles on the Norse settlements is a general account by Finnur Jonsson based on historical records This is followed by a description of the farm sites by Daniel Brunn, in this article reference is made particularly to the economic conditions considered likely at the time of the occupation Finally, Dr Norlund summarises the finds made at the Herjolfsnes burial ground in 1921, when well preserved clothing of fourteenth and fifteenth century type was found in ground now permanently frozen Dr Norlund concludes that the colony died out as a result of the consequences of unsatisfactory diet, and that there was a complete absence of any intermingling with Eskimo The view that there had been a setting in of colder conditions is apparently not so confidently held The three articles on the Norse settlements are brief accounts of a subject on which lately a good deal has been written they show that Danish writers at any rate have refrained from making the history of the old colonies in any way fictitious or unduly sensational

Both Eskimo and Norse sections of the book constitute most admirable accounts of the past history of Greenland and of the living conditions found there to day This book is definitely the authoritative work on Greenland and Greenlanders Apart from its being indispensable, it is exceedingly well written and well produced

J M WORDIE

Our Bookshelf

Die Tierwelt der Nord und Ostsee Begrundet von Grimpe und E Wagler Herausgegeben von G Grimpe Lieferung 15 Teil 9a *Aculifera*, von H J Nierstrasz und H Hoffmann, Teil 11 f *Thalassobionte* und *thalassophile Myriapoda*, von O Schubart, Teil 12h, *Pisces* Pp 64 + 20 + 141 + 164 (Leipzig Akademische Verlagsgesellschaft m b H, 1929) 8 80 gold marks

WITH the fifteenth *Lieferung* (12 h 3) of this work the portion dealing with the fishes ends, the present part consisting of an appendix dealing chiefly with distribution The fishes can now be obtained in a separate volume entitled " Die Fische der Nord- und Ostsee " In Part 9a (Aculifera), Drs N F. Nierstrasz and H Hoffmann give a good account

of the Aplacophora and of the Chitons In Part 11 f (Thalassobionta and thalassophile Myriapoda), Dr Otto Schubart describes the maritime and submaritime Myriapods There are a large number of the Aplacophora in this region, but although their anatomy is fairly well known, there is a lamentable gap in our knowledge of their development and life histories, the chief work on these having been done with species from elsewhere The same may be said of the Placophora, although more is known of this group and the eggs of a few of our common forms have been seen All the species are very clearly described and figured with details of the plates, so that identification should be easy, and the anatomy, biology, and distribution are fully discussed

The large number of myriapods which are more or less marine is surprising Most of these live on the shore between or above tidemarks, and they belong to several different groups Dr Schubart gives a very interesting account of these, especially with regard to their biology Some of them can remain alive under water many days, although not so long in salt water as in fresh, and in no case is it a natural habitat Damp, salty situations are by no means avoided, the chief localities being rocky and stony shores The internal anatomy is barely touched upon, but much space is given to the distribution and ecology of the species Most of the illustrations are original photographs or line drawings

A School Geometry By A Walker and G P McNicol Part 1 (Books I III) Pp viii + 256 3*s* 6*d* Part 2 (Books IV VII) Pp vi + 251-492 3*s* 6*d* Part 2, Section 1 (Books IV V) Pp vi + 251 352 2*s* Part 2, Section 2 (Books VI VII) Pp vi + 351 480 2*s* (London, New York and Toronto Longmans, Green and Co , Ltd , 1930)

THIS book is an improved version of the type of text book on elementary geometry that began to appear about thirty years ago It is carefully written and the supply of exercises is better than in some of the older books, but there is the traditional emphasis on 'bookwork' which seems somewhat out-of-date When examination papers in geometry consisted half of Euclid's propositions and half of riders demanding some real geometrical power, all that teachers could hope to do for their feebler pupils was to get them to understand enough about the subject to write out the propositions intelligently Nowadays, what is demanded is some power of independent thought sufficient to answer simple questions which, though they can scarcely be called riders in the old sense, are definitely not bookwork It is found possible to satisfy this demand save in very exceptional cases, and it can scarcely be doubted that the modern training is the more valuable

The process of learning propositions in a definite sequence, whether Euclid's or some other, comes nowadays later in the geometry course, and is not generally regarded as the matter of primary importance Therefore a text book arranged like this one, on traditional lines, is not probably the most convenient, especially for an inexperienced teacher who is perhaps doubtful about how the reading should be arranged

The printing and general arrangement of the book reflect the greatest credit on the printers and publishers A R

Leçons sur les systèmes d'équations aux dérivées partielles Par Prof Maurice Janet (Cahiers scientifiques, Fascicule 4) Pp viii + 125 (Paris Gauthier Villars et Cie, 1929) 30 francs

PROF M JANET has produced a valuable contribution to the analytical theory of partial differential equations It opens with a clearly written introduction in which are discussed the chief problems arising out of the general theory to be considered Then follow two chapters on " Calcul inverse de la dérivation ", existence theorems, and the linear partial equation of the second order in one unknown function These chapters lead logically to the development of the most important part of the subject with which the book is concerned, namely, the reduction of any system of equations to the canonical system of Riquier The final chapter is devoted to systems in involution, in which another canonical form is considered This is based upon M Cartan's development of the Pfaffian system

Numerous examples providing particular applications of the general theory are given Many of these are followed by interesting analytical notes Finally, valuable notes upon convergence of series solutions and the characteristic multiplicity of systems, together with a bibliographic summary for further reading, are given as an appendix

Plane Trigonometry By Prof J B Rosenbach and Prof E A Whitman Pp ix + 216 (New York John Wiley and Sons, Inc , London Chapman and Hall, Ltd , 1929) 10*s* net

THIS is, in general, quite a well written book, though, in some respects, on old lines It covers elementary trigonometry to the logarithmic solution of triangles, and makes a good beginning by defining the functions of angles of any magnitude with the aid of co ordinates Circular measure is also developed early and used frequently throughout the text If, however, it is deemed necessary to devote a section to the theory and practical use of logarithms, there seems no reason for deferring such to the last chapter, especially when logarithms are freely used from Chapter ii onwards The section on the linear equation $a \cos \theta + b \sin \theta = c$ is not wholly satisfactory Greater emphasis should be laid on the introduction of irrelevant roots by squaring than is given in Ex 2 on p 108 The method of transforming to a quadratic in $\tan \frac{1}{2}\theta$ does not seem to be dealt with

There are plenty of good examples for which five figure tables are required, but some of the calculations involved are unnecessarily heavy The book is well printed, and answers to the examples are provided

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

The Ovary Stimulating Hormone of the Placenta

THE production of prematurity in young female rats and mice by Smith and Engle in America, and by Zondek and Aschheim in Germany, through the use of the anterior pituitary gland transplant or emulsion has afforded a great stimulus to further investigation of the hormonal control of gonadal activity The latter investigators have demonstrated that effects somewhat similar to those following pituitary gland implantations can be elicited in immature rats and mice by extract of pregnancy urine which has been rendered œstrin free They have likewise shown decidua, placenta, the corpus luteum of pregnancy, as well as pregnancy blood, to contain an ovary stimulatory hormone analogous to that of the anterior pituitary gland

Dr B P Wiesner, of the University of Edinburgh, experimented extensively with extracts of the placenta by the use of sulphosalicylic acid He is of the opinion that his own experiments have demonstrated the existence in placenta of two hormones, one of which he called 'Rho I', which is œstrogenic in action, causing prematurity phenomena in rodents, the other, 'Rho II', has a luteinising action on the ovary and causes a state of pseudo pregnancy (see Wiesner, *Edin Med Jour*, February 1930, p 73)

Dr Wiesner visited my laboratory in September 1929, and asked me to take up the problem of concentration and purification of the ovarian stimulatory hormone of placenta which he has termed 'Rho I' The problem was, therefore, made a subject of special study in this laboratory, and the results of our investigations to date, which appear to be of great interest, may be summarised as follows

1 The placenta (human or ox) contains an ovary-stimulating hormone the injection of which into immature rats and mice causes prematurity phenomena (Confirming Zondek and Aschheim, and Wiesner)

2 The active principle has been obtained in a fraction which is micro crystalline in character After repeated recrystallisations, 0 0015 mgm of such a fraction has been found to represent one rat unit

3 Active extracts which have been rendered protein- and lipoid free, as well as œstrin free have been standardised in terms of rat units The manifestation of prematurity phenomena (confirmed by microscopic sections of ovary, uterus, and vagina) has been the basis of the biological test

4 Active extracts have been shown to withstand *in vitro* digestion with pepsin and trypsin without appreciable loss of their physiological activity

5 It has been repeatedly demonstrated that potent extracts may be effective when administered by the oral route The amount of extract, administered orally, required to produce definite stimulation of the immature ovary may be very little more than the effective subcutaneous dose

6 The effects of daily injections, over long periods, of active extracts have been studied in relation to the histology of the genital tract and also in relation to pregnancy and lactation in the adult female rat

7. Immature female rats, as a rule, become cyclic following the induction of prematurity phenomena

8 Several instances of normal mating have occurred in treated rats thirty five to fifty days of age.

9 Adult rats which have received two to ten rat units daily have manifested the normal cyclic changes, have been impregnated and produced litters of normal size at the normal gestation period, and have shown no impairment of lactation Some of these rats are now in their third pregnancy since the injections began

10 Clinical trial of the placental extract in a selected group of cases of ovarian hypofunction, with the collaboration of Dr A D Campbell, has been productive of results which are most encouraging

This phase of our work at McGill University is now a subject of intensive study With the co operation of the staffs of the Royal Victoria and Montreal General Hospitals, the following types of cases are being studied

(*a*) Delayed puberty, (*b*) dysmenorrhœa, (*c*) amenorrhœa, (*d*) metropathia hæmorrhagica, (*e*) menopause, (*f*) toxæmia of pregnancy, (*g*) certain neurological and psychiatric cases, (*h*) thyroid dysfunction

The extract, in liquid form, is being administered by mouth

11 It is our opinion, in the light of experimental evidence, that the hormone of the placenta with which we are dealing is not identical with the anterior pituitary ovary stimulatory principle ('Rho I' of Wiesner) It is produced, we believe, by an active process in the placenta itself Its physiological effects on rodents are suggestive of the all or nothing law It will activate an immature or hypofunctioning ovary, but has little effect upon the normal organ, and no effect on a castrated individual

If we are correct in this assumption, then one should be able to demonstrate that the diseased placenta produces less of the active principle Assay experiments which are now being made on placenta, both normal and pathological, obtained at various periods of gestation, will do much to settle this point

J B COLLIP

Biochemical Laboratory,
McGill University,
Montreal, Canada, Feb 20

The Crystalline Style of the Mollusca and a Carnivorous Habit cannot Normally Co-exist

THE crystalline style of the Lamellibranchs and many Gastropods consists of a gelatinous rod formed of protein of a globulin type It would, therefore, be readily digested by any extracellular proteoclastic enzyme in the alimentary tract Since the development of the carnivorous habit demands (with such rare exceptions as the one noted below) the presence of an enzyme capable of breaking down the flesh of the prey into soluble polypeptides and amino acids (for example, in Cœlenterates, Decapod Crustacea, and Cephalopods), it follows that a mollusc cannot normally both possess a style and be a carnivore

A brief survey of those molluscs which possess a style will emphasise this point The style is universally present in Lamellibranchs Here feeding is by ciliary mechanisms, the food being selected according to size only There is no extracellular protease in the gut, the only extracellular enzyme being that set free by the dissolution in the stomach of the head of the style and that acts exclusively on starch and glycogen (Yonge [1]) Zooplankton may survive passage through the gut Minute particles of animal matter (for example, blood corpuscles from fish) may be ingested and digested by wandering phagocytes which pass through the gut wall into the lumen and thence back

into the tissues More minute matter still may be digested intracellularly by the cells of the digestive diverticula The principal food of Lamellibranchs is fine phytoplankton

In the Gastropods the style is present in a variety of genera (see Robson [2] and Mackintosh [3]), but on examination these are seen to fall into two groups according to the mode of feeding There are (1) those that have ciliary feeding mechanisms and (2) those that scrape their food with a radula Examples of the first are provided by *Crepidula*, *Calyptræa*, *Capulus* (Orton,[4] Mackintosh,[3] Yonge[5]), *Vermetus* (which I have recently had the opportunity of examining on the Great Barrier Reef) and their allies among the Tænioglossa, and the Thecosomatous Pteropods (Yonge [6]) among the Tectibranchs In the latter case the gradual loss of the radula, jaws and 'salivary' glands handed down from carnivorous ancestors, in the series *Cavolinia*—*Cymbulia*—*Gleba*, with a simultaneous evolution of a more perfect ciliary feeding mechanism and of a small style (Meisenheimer [7]), is especially striking In the second class are included many 'scrapers' (Yonge [8]) of vegetable food, such as *Patella* in the Docoglossa, *Fissurella* in the Rhipidoglossa, and a variety of Tænioglossa including *Paludestrina*, *Turritella*, and *Aporrhais* (see Robson [2] and Mackintosh [3] for full list) Perhaps the best case is that of *Lambis* (Pterocera), which has a large firm style lying in a separate sac (Woodward [9]), the animal feeding by means of a delicate radula on the softest of filamentous weeds As I found in Australia, this animal has no extracellular protease in the gut, the 'salivary' glands are absent or degenerate, and is so specialised a herbivore as even to possess a powerful extracellular cellulase

The details of my investigations on reef molluscs will be published in due course

Passing to typical carnivorous Gastropods, very different conditions are found In *Natica*, *Murex*, *Pterotrachea*, and *Pleurobranchœa* (Hirsch [10]) there are in all cases powerful proteases in the alimentary canal secreted by the 'salivary' glands and possibly also by the digestive gland in the first two, and by the latter alone in the last two In *Sycotypus* (Mendel and Bradley [11]) the 'salivary' glands secrete a powerful protease, the secretion from the digestive gland being concerned only with the digestion of fats and carbohydrates

There is one exception which, to an unexpected degree, proves the rule The Septibranchs (Yonge [12]) have lost the ciliary feeding mechanisms of the other Lamellibranchs and developed a muscular feeding mechanism operated by the movements of the septum which enables them to swallow dead or dying animal prey, such as small Crustaceans, Annelids, etc The stomach has lost the sorting function it possesses in the other Lamellibranchs, has elongated, developed an interior horny lining and powerful circular and longitudinal muscles, and in this way become a crushing gizzard in which the prey is broken into fine fragments The small style is apparently practically functionless There is *no* free protease in the alimentary tract, the food particles being conveyed through the exceptionally wide ducts into the tubules of the digestive diverticula, where they are digested intracellularly

In my first paper on *Mya* (Yonge [13]) I attributed the dissolution of the style in the stomach to a secretion from the digestive diverticula of a protease I have since had a number of opportunities of correcting this error; the digestive diverticula of the Lamellibranchs do *not* secrete The style, as pointed out previously in these pages (Yonge [14]), which consists of an amphoteric protein, is solid at the low pH of its formation (4 5-5 8 according to the species), but dissolves in the less acid contents of the stomach, thereby releasing the enzyme and lowering the pH of the stomach contents to about the optimum conditions for the working of the enzyme (Yonge [5]) Its disappearance in animals where the style-sac is in free communication with the intestine is due to unfavourable conditions causing a decrease in secretory activity which is no longer able to keep pace with the process of dissolution

Summarising, it can be stated with confidence that the presence of a crystalline style in any mollusc is a certain indication that the animal in question possesses *no extracellular proteoclastic enzymes* and so cannot digest any but the very minute particles of protein matter which can be ingested intracellularly Such an animal is, therefore, except where a powerful crushing gizzard is present as in the Septibranchs, a specialised herbivore

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Feb 27

[1] Yonge, *Jour Mar Biol Assoc* 14, 205 1926
[2] Robson *Proc Malac Soc Lond*, 15, 41, 1922
[3] Mackintosh, *Quart Jour Micr Sci* 69, 317 1925
[4] Orton, *Jour Mar Biol Assoc* 9 444, 1912
[5] Yonge *Jour Mar Biol Assoc* 13, 938, 1925
[6] Yonge, *Jour Linn Soc Lond*, 36, 417 1926
[7] Meisenheimer, *Wiss Ergebn Tiefsee Exped Valdivia* 9, 1905
[8] Yonge *Biol Reviews* 3, 21 1928
[9] Woodward, *Proc Malac Soc Lond*, 1, 143, 1894
[10] Hirsch, *Zool Jahrb Abt Zool u Physiol* 35 357 1914
[11] Mendel and Bradley *Amer Jour Physiol* 13, 17 1905
[12] Yonge *Phil Trans Roy Soc Lond* (B), 216 221, 1928
[13] Yonge, *Brit Jour Exper Biol* 1, 15, 1923
[14] Yonge NATURE, 117 691 1926

Contamination by Dust Particles and Intensive Desiccation

As is stated by H B and M Baker in their 1912 article, it was a letter in regard to desiccated calomel that led them to study the effects of intensive desiccation on boiling points and other physical properties of liquids, a field in which the many investigators who have since entered it have obtained results that are outstandingly discordant In looking back at the work of Smith and Menzies, published in 1911, one can readily see that, in working with calomel, they were fortunate in being able to heat the substance to be desiccated for months at 115°, while the drying agent, in another portion of the same apparatus, could be kept at room temperature But one can recall also a feature of the work that is not obvious, namely, that, by reason of the methods used, their dry system was presumably unusually free from contamination with atmospheric dust Recent work in this laboratory has again brought to our attention the importance of atmospheric dust

One finds that salt hydrates show periods of induction, not only preceding the process of dehydration, as was remarked by Faraday and has been since confirmed by many others, but also preceding the processes of rehydration and of deliquescence This has been best observed with crystals grown from a state of lower hydration by gain of water from the vapour phase If such crystals are grown within a closed vessel, the conditions are favourable for the formation of a virgin surface, which refuses to be readily hydrated

Under suitable conditions the gain of water, once begun, proceeds with that change of rate through a maximum which is characteristic of an autocatalytic process This is in agreement with Langmuir's hypothesis, which, for this case, would state that the addition reaction which transforms the lower to the higher hydrate takes place only in the region where both the solid phases are in contact The presence

of the higher hydrate, the function of which may possibly be filled by other solids, isomorphous or otherwise, furnished by dust, promotes the reaction Dust may even furnish particles of salts that are deliquescent under the conditions of the experiment, thus making possible hydration of the salt studied by water in the liquid phase One could not, therefore, hope to observe, nor does one observe, the behaviour mentioned above if starting nuclei, furnished by dust, were thickly spread over the surfaces of the crystals of the lower hydrate In such a case, the induction period would be lacking and the rate of reaction a steadily diminishing one as the zone of reaction progressed, with diminishing area, toward the centres of the crystals, and this has been the common observation in the past The induction period observed, under suitable conditions, prior to combination with water, and the initial slowness of the process, may well explain the experimental findings reported in the literature concerning the unexpected inefficiency of such substances as anhydrous cupric sulphate or calcium oxide when used for the drying of gases

With reference to the effect of intensive desiccation on the boiling points of liquids, F O Rice has very properly considered the presence of dust as affecting superheating, although without illuminative result, and he pointed out further that dust particles present, if they also must be dried, will delay the drying of a system containing a liquid It may be added that certain substances contributed by dust particles may promote the changes under observation just as effectively as does water itself

One should recall, also, the independent and concordant findings of Wolski and of Kenrick that ordinary distilled water contains about 20,000 motes per cubic centimetre Other distilled liquids may be in like case Moteless water shaken in ordinary 'clean' glass apparatus rapidly acquires many motes Even dismissing from consideration the motes suspended in the liquid, one is able to bring forward additional reasons, beyond the mere sealing of capillaries, for timeously heating to the fusion point all glass apparatus designed for work on the effects of intensive desiccation For example, this fusion of the glass may flux and fix the loose scale that yields the motes, and will certainly enormously diminish the area of the quasi porous internal surface of glass that has been cleaned and roughened by cleaning solution Again, the fusion process may engulf and incorporate beneath a relatively plane glass surface dust particles of such ubiquitous salts as sodium chloride, as well as the ash of those organic particles which, in using Baker's air current technique rather than the vacuum technique for drying apparatus, have been burned to ash

Fuller reports of studies of these matters will appear elsewhere

Alan W C Menzies
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New Jersey, U.S.A.
Feb 11

The Green Flash in Southern California

Since my earlier letter on this subject (Nature, Aug 4, 1928) was written, I have made many more observations of the flash at sunset and many of the flash at sunrise Most of the flashes at sunset have been seen from our former residence on a hill near the old campus of the University, from our present residence and the new campus itself in Westwood Hills, from the streets of Los Angeles, and from the beaches near Los Angeles, as the sun has set over the Santa Monica Mountains, Santa Catalina Island, the ocean, or clouds lying low above the ocean or mountains All but one of the flashes at sunrise have been seen from Westwood Hills as the sun has risen over the Baldwin Hills and other elevations east and south east, while one of the most beautiful was seen from a peak on the eastern rim of Death Valley

The observations of these beautiful but variable phenomena have been very numerous Usually no record has been kept, but in the 32 day interval Aug 20–Sept 20, 1928, I witnessed the flash at sunset 13 times, and I am confident that I have since seen a greater number of sunset and sunrise flashes in an interval no greater In the 32 days referred to, fogs and clouds interfered on 9 days, the back ground of sky was too bright on 3 days, observations could not be made on 5 days, although it is practically certain that the flash would have been seen on some of these days if it could have been looked for, and on 2 days the flash was not seen when conditions were judged favourable for its appearance It is probable that the flash was seen also on one of the days mentioned above as having too bright a sky On this occasion three observers in Tujunga watched the sun set over the Verdugo Hills, which were too close and too high for satisfactory observation, and two out of the three reported that they saw the flash On account of the numerous fogs and cloudy horizons at the beaches here, it is usually easier to get the flash over the mountains or hills than over the ocean, since the elevations are likely to be high enough to be out of the fog and low enough and remote enough to give sufficient dispersion

I have repeatedly witnessed the transition between the blue and the green of the flash, and also the yellowish green of the upper portion of the sun which often precedes the flash at sunset and follows it at sunrise

Contrary to what appears to be the usual impression, the green flash is at least as easy to observe when the sun is considerably reddened as when it is bright I have sometimes been surprised that the sun could be so red and yet have sufficient green left to show the flash The blue, of course, does not appear in such circumstances

Many of the observations referred to, including one of the most brilliant, have been over low lying clouds On one occasion I saw the sun flash green first over the top of a cloud, and then, a little later, through a hole in the cloud

On a number of occasions I have seen double flashes as the sun has set, first over a low lying cloud and shortly afterward over the ocean beneath, and on one occasion I witnessed what I believe to have been a triple flash, as follows The sun first set over a low cloud and flashed green, then it set over the sea beneath and flashed green, and finally the light reflected from the lower surface of the cloud to the sea turned green before it disappeared

S J Barnett
University of California at Los Angeles and
California Institute of Technology, Feb 3

Taxonomic Importance of the Terminal Segments of Psychodid Larvæ

Although in the last quarter of a century a considerable amount of advance has been made in various parts of the world towards the classification and morphology of the imago of the family Psychodidæ, our systematic knowledge of the immature stages of the group is surprisingly scanty This is perhaps due in the first place to the secluded nature of the breeding places of the members of this family, and secondly to the fact that, unless and until the complete life history of each species is studied thoroughly in the laboratory,

one is not in a position to place an egg, a larva, or a pupa to a particular species. While engaged in the breeding of sandflies at the Kala-azar Research Laboratory of the Calcutta School of Tropical Medicine and Hygiene, I had an excellent opportunity of studying the immature stages and more especially the larvæ of the species occurring locally.

During a course of systematic study of the larvæ bred from strains of known species, I found that the specific differences are prominently confined to the two terminal segments in the case of the genus *Phlebotomus* and only to the last segment in the case of the genus *Psychoda*. Owing to the semi-aquatic nature of environment adapted by *Psychoda* larvæ, the terminal segment becomes modified into a tubular structure with the spiracular openings arranged at its tip; specific variation was also observed in the case of the sclerites surrounding the anal pore. The *Phlebotomus* larvæ, on the other hand, are remarkably terrestrial (with a series of pseudo-legs), and with the modification of the sclerites of the dorso-ventrally flattened terminal segment admirably adapted as an adjunct organ of locomotion in the larvæ as well as a fixing structure for the pupæ, the posterior pair of spiracles becomes shifted to the penultimate segment in the larvæ. The structural modifications of the terminal segments of two genera and five species occurring locally have been studied by me and my classification is based on the variable nature of these structures. The following genera and species have been studied: Genus *Psychoda*; *Psychoda bengalensis* Brun.; *Psychoda plumosa* sp. nov.; Genus *Phlebotomus*; *Phlebotomus argentipes* Ann. and Brun.; *Phlebotomus papatasii* Scop.; and *Phlebotomus* (*babu*) *minutus* Rond.

A detailed work on this line is in progress and will be published elsewhere.

S. MUKERJI
(Entomologist under the Indian Research Fund Association).
Kala-azar Research Laboratory,
Calcutta School of Tropical Medicine and Hygiene,
Calcutta, Feb. 13.

Integration of Sunlight in the Tropics

A PHOTO-ELECTROLYTIC method of integrating sunlight has been described by Atkins and Poole (*Proc. Roy. Dub. Soc.*, vol. 19, p. 159). The electric current in a photo-electric cell is proportional to the light falling on it, and the latter can be integrated over any period of time, by measuring electrolytically the total quantity of electricity that passes through a sensitive voltameter in series with the cell. In Dublin, where this method of sunlight integration has been carried out, the average illumination for a bright sunny day in November was estimated as 10,000 metre candles for ten hours.

Using a modified form of the apparatus, which will be described elsewhere, similar investigations have been carried out by us in Rangoon. The observations were made during the early part of November, and it may be of interest, for comparison purposes, to record the results which have been obtained during one week, when the illumination from day to day was decidedly variable. With the apparatus employed a deposit of 8.81×10^{-10} gm. of copper corresponds to an average illumination of 500 m.c. for one second, and the light was integrated each day over a period of six hours.

For bright sunny days, the copper deposited varied from 9.9 mgm. to 12.4 mgm., corresponding to an average illumination of about 250,000 to 325,000 m.c. A day of variable sunlight gave a deposit of 4.9 mgm. corresponding to an average illumination of 125,000 m.c., whilst the illumination on a particularly dull day was about 60,000 m.c.

In the British Isles an average of 50,000 m.c. is quoted as a reasonable figure for a twelve-hour bright summer's day, which appears to be about the same as that obtained by us over a shorter period, during a particularly dull day in the tropics, whilst the average illumination over a sunny day in the tropics is considerably in excess of the maximum illumination attained during a summer's day in the British Isles, which is quoted as reaching approximately 150,000 m.c. A method is being devised of increasing the sensitivity of this method of sunlight integration, so as to obviate the necessity of employing very sensitive methods of chemical analysis, which is a disadvantage when a great number of records are being made.

It is intended to make a complete study of the illumination at different times of the year, and, under various conditions, also to record diurnal variations in the illumination.

J. A. C. TEEGAN.
G. R. RENDALL.
University College,
Rangoon, Jan. 15.

The Gibbs-Ewald Reciprocal Lattice

As I received no proof of the note appearing under the above title in NATURE of Feb. 15, p. 238, I wish here to correct certain misprints and to make some slight modifications which would otherwise have been made in the proof.

In line 7, for K read k, and in the equation in line 14, read for l, the exponential e. The distance between any two adjacent planes is of course $n/(u_1^2+u_2^2+u_3^2)^{\frac{1}{2}}$. [The fractional index was omitted from the original letter.—Ed., NATURE.]

In the penultimate paragraph, I wish to delete all but the first sentence, and to substitute the following: "With the usual summation convention we write

$$e^{2\pi i u_i x^i} = 1,$$

both sets of co-ordinates being referred to an affine system of oblique axes[2] of constants a, b, c, and angles α, β, γ, appropriate for the crystal under consideration." In accordance with this modification the transformation equation of the last paragraph would then read $F(u_i x^i) = 0$.

A. L. PATTERSON.
Rockefeller Institute for Medical Research,
New York City.

A Superconducting Alloy with Resistance Temperature Hysteresis

IN some experiments made in collaboration with J. F. Allen and J. O. Wilhelm, we found that the resistance of a ternary alloy of bismuth, lead, and tin dropped slowly with temperature in the usual manner down to 9° K., where it suddenly fell to zero. On raising the temperature, the alloy remains superconducting up to a temperature of 13.2° K., at which point the resistance reappeared and rose quickly to a steady value at 13.8° K. This would appear to be the first time that a resistance temperature hysteresis effect has been observed and measured.

J. C. MCLENNAN.
University of Toronto.

Early Man in China.

By Prof G ELLIOT SMITH, F R S

THE reconnaissance inaugurated in 1921 by Dr J G Andersson on behalf of the Geological Survey of China has brought to light evidence of exceptional interest and importance for students of archæology and human palæontology In the province of Honan, Dr Andersson discovered a rich industry, including painted pottery, the cultural link of which with ancient Sumer is widely admitted It provides positive confirmation of the early diffusion of culture from Mesopotamia to the eastern limits of Asia during the third millennium B C In addition, he recovered a number of interesting human remains in association with the early industries in Honan and Kansu His survey has also been responsible for the discovery of the fossil remains of the early Pleistocene genus of the human family which Prof Davidson Black called *Sinanthropus*—roughly contemporaneous with *Pithecanthropus* and *Eoanthropus*

(1) In *Palæontologia Sinica* (Series *D*, Vol 6, Fasc 1) Prof Davidson Black has completed the statistical investigation of the Kansu and Honan skulls found with the painted pottery and has compared them with specimens from later Kansu prehistoric sites as well as with more recent crania from northern China and elsewhere In this laborious work, he has followed the mathematical methods devised by Prof Karl Pearson and his school The interest and value of this elaborate monograph is not diminished by the fact that the results obtained fully confirm those announced in 1925 from simple observation, before Dr Black had begun the statistical analysis of the material He has now established the fact that the prehistoric population of eastern Asia in the third millennium B C was sufficiently akin to the modern inhabitants of northern China to justify the application to them of the term 'proto-Chinese' He notes, further, that the earlier members of his series diverge much more widely from the modern type than do those of the later prehistoric phases of culture In certain suggestive features the earliest types present some near resemblances to the Khams-Tibetan type described by Dr Morant

(2) Prof Davidson Black is to be congratulated on the promptitude with which from time to time he has placed at the disposal of anthropologists the information relating to the various discoveries of fossil remains of *Sinanthropus* The "Preliminary Note on Additional Sinanthropus Material" issued in the *Bulletin of the Geological Survey of China* (Vol 8, No 1, 1929) deals with the material found in the autumn of 1928 at Chou Kou Tien in the course of excavations carried out by Dr Birger Bohlin, Dr C C Yong, and Mr W C. Pei Previous to this discovery, the new genus was known only from a few teeth, but in 1928 the excavators found, in the neighbourhood of the place where the tooth-type had been recovered in the previous year, the greater part of the right horizontal ramus of an adult lower jaw with three molar teeth *in situ*, and the sockets of the premolar, canine, and distal half of the lateral incisor preserved In addition, more than twenty teeth, both deciduous and permanent, representing many phases of wear and differences in age, were found, together with the front part of the lower jaw of a child The fragments of jaws, adult and infantile, were embedded in blocks of travertine, and at the time the report was published the associated cranial fragments had been only incompletely freed from the stony matrix The piece of the child's jaw was intimately associated in the block of travertine with a parietal bone of corresponding age Although this part of the braincase had not been extracted from the matrix, sufficient of it was visible to enable Dr Davidson Black to say that it was definitely human in type and represented part of a roomier braincase than that of *Pithecanthropus*

The importance of this association of part of a human skull with a fragment of jaw of corresponding age is of special interest because the jaw presents simian peculiarities of conformation such as, in the case of the Piltdown jaw, aroused in the minds of many foreign palæontologists doubt as to the possibility of association with a human skull The present report, providing more than forty photographs and skiagrams of the new specimens, and comparative data to permit an exact comparison with known specimens, makes it possible for anthropologists throughout the world to appreciate the exact nature of the material which has been found and to estimate its vast significance

This discovery justified Prof Davidson Black's bold action in creating a new genus on the evidence of a tooth The far-reaching importance of the fossils found in 1928 is enhanced by the even more startling discovery made on Dec 2, 1929, by Mr W C Pei, of a complete braincase of an adult skull of *Sinanthropus*, which is uncrushed This new specimen is unique it is the only complete braincase of early Pleistocene man so far known It brings home in a much more convincing way than the recovery of mere fragments, the reconstruction of which invariably excites suspicion in the minds of most people, the tremendous significance of the discoveries in China For this braincase is more complete than the remains of either *Pithecanthropus* or *Eoanthropus*, and, contrary to the anticipations which were made last year (when a jaw was found presenting features hitherto unknown in any other human remains except *Eoanthropus*), displays a form more nearly akin to the Javanese than to the Piltdown fossil

The photograph recently received in England, reproduced as Fig 1, represents the skull in the state it reached the laboratory in Peking The base is still embedded in plaster of Paris and the occipital bone is hidden almost as far as the lambda.

In the accompanying diagram (Fig 2), made by Miss Eleanor Dale, the contour of the part of the skull of *Sinanthropus* displayed in the photograph

is shown by the line *A* The dotted line is merely a tentative suggestion of the form of the skull with a drawing of the fragment of an adult jaw found in 1928 The contours of the cranial vaults of *Pithecanthropus* (*B*) and the type specimen of Neanderthal man (*C*), both presenting analogous forms, have been inserted for comparison, the inch-scale providing the criterion of exact size Its resemblance to the Neanderthal skull is discounted by the significant difference in actual size

With the photograph Prof Davidson Black has sent the following information

Within the main cave deposit at Chou Kou Tien, up to the present time, *Sinanthropus* remains have been recovered from five different sites, three of which, including the latest, have been discovered by Mr Pei during the last season's work Contrary to the reports which have been circulated, no skeletal parts other than the skull and numerous isolated teeth have been recovered during this year's excavations Remains of at least ten individuals belonging to the genus have been found

It should be noted that the different sites where

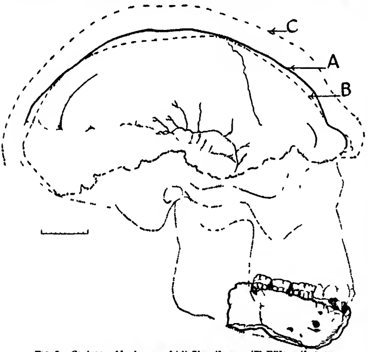

FIG 2 —Contours of brain-case of (*A*) *Sinanthropus*, (*B*) *Pithecanthropus*, (*C*) Neanderthal man.

Sinanthropus has been discovered within the main Chou Kou Tien deposit are all clearly contemporaneous with one another, being Lower Quaternary (Polycene) in age. This statement is based on the investigations of Père Teilhard de Chardin and Dr C C Yong on the geology and palæontology Though hundreds of cubic metres of material have

FIG 1 —Brain case of *Sinanthropus*

been examined, no implements or artefacts of any nature have been found, nor has any trace of the use of fire been observed

The greater part of the left side and the fore part of the base of this unique braincase of *Sinanthropus* is still embedded in a block of very hard travertine The vault of the skull from its massive brow ridges to the occiput, and the whole right side of the specimen was, however, encrusted with a relatively soft matrix, which was removed before the photograph was taken It is apparent that the braincase has been almost completely preserved while most of the facial region seems to be lacking

The skull of *Sinanthropus* is of approximately the same length as that of *Pithecanthropus* and, like the latter, is provided with massive brow ridges However, *Sinanthropus* differs from the Java type in the following important features Relatively well-developed frontal eminences, well-localised parietal eminences, and greater height of skull vault, all these characters pointing to a relatively greater brain capacity in *Sinanthropus* The mastoid processes are small and rugged The sockets in which the lower jaw articulated are well preserved on both sides, a circumstance which will be of great value when the task of reconstructing the lower jaw (shown in Fig 2), recovered in 1928, is undertaken

Discovery of a Trans-Neptunian Planet.

By Dr A C D Crommelin

On the evening of Mar 13 (an appropriate date, being the anniversary of the discovery of Uranus in 1781, and Mar 14 being the birthday of the late Prof Percival Lowell) a message was received from Prof Harlow Shapley, director of Harvard Observatory, announcing that the astronomers at the Lowell Observatory, Flagstaff, Arizona, had been observing for seven weeks an object of the fifteenth magnitude the motion of which conformed with that of a planet outside Neptune, and agreed fairly closely with that of one of the hypothetical planets the elements of which had been inferred by the late Prof Percival Lowell from a study of the small residuals between theory and observation in the positions of Uranus That planet was better suited than Neptune for the study, since the latter had not been observed long enough to obtain the unperturbed elements

Lowell's hypothetical planet had mean distance 43 0, eccentricity 0 202, longitude of perihelion 204°, mass 6½ times that of the earth, period 282 years, longitude 84° at the date 1914–15 Its position at the present time would be in the middle of Gemini, agreeing well with the observed place, which on Mar 12 at 3h U T was 7 seconds of time west of δ Geminorum, the position of the star was R A 7h 15m 57 33s, north decl 22° 6′ 52 2″, longitude 107 5° This star is only 11′ south of the ecliptic, making it likely that the new planet has a small inclination As regards the size of the body, the message states that it is intermediate between the earth and Uranus, implying perhaps a diameter of some 16,000 miles A lower albedo than that of Neptune seems probable, to account for the faintness of the body It appears from a New York telegram that at least one visual observation of the planet has been obtained, from which the estimate of size may have been deduced

Mention should also be made of the predictions of Prof W H Pickering, one of these, made in 1919 (*Harvard Annals*, vol 61), gives the following elements, Epoch 1920, longitude 97 8°, distance 55 1, period 409 years, mean annual motion 0 880°, longitude of perihelion 280°, perihelion passage 1720, eccentricity 0 31, perihelion distance 38, mass twice earth's, present annual motion 0 489° This prediction gives the longitude for 1930 as 103°, which is within five degrees of the truth, actually it was in longitude 108° at discovery Prof Pickering's later prediction is further from the truth, making the longitude about 131°

Gaillot and Lau also made predictions, like the other computers they noted that there were two positions, about 180° apart, that would satisfy the residuals almost equally well Taking the position nearest to the discovered body, Lau gave longitude 153°, distance 75, epoch 1900 Gaillot gave longitude 108°, distance 66, epoch 1900 The latter is not very far from the truth, with a circular orbit, the longitude in 1930 resulting from Gaillot's orbit would be 128°, some 20° too great Gaillot performed the useful work of revising Le Verrier's theory of Uranus, thus giving more trustworthy residuals Lowell pointed out that the residuals of Uranus that led to the discovery of Neptune amounted to 133″, while those available in the present research did not exceed 4 5″, yet even in the case of Neptune the elements of the true orbit differed widely from the predicted ones, though the direction of the disturbing body was given fairly well He noted that in the present case it would be wholly unwarrantable to expect the precision of a rifle bullet, if that of a shot gun is obtained, the computor has done his work well

Another method of obtaining provisional distances of unknown planets is derived from periodic comets, the mean period of the comets of Neptune's family is 71 years, it is pointed out in the article on comets (" Encyc Brit " 14th edition, vol 6, p 102) that there is a group of five comets the mean period of which is 137 years, as stated there, " This family gives some ground for suspecting the existence of an extra-Neptunian planet with period about 335 years, and distance 48 2 units " This seems to be in fair accord with the new discovery, but probably the distance is nearer 45 than 48 Comets also suggest another still more remote planet, with period about 1000 years, a suggestion which has also been made by Prof G Forbes and by Prof W H Pickering

The question has been asked, " Does the new planet conform to Bode's law ? " It is difficult to assign a definite meaning to this question, since Bode's law broke down badly in the case of Neptune, Neptune's predicted distance was 38 8, its actual distance 30 1 For Bode's law, each new distance ought to be almost double the preceding one, the constant term of the law becomes negligible when the distance is great, For the extension of the terms given by the law we might (1) ignore Neptune as an interloper and take the next distance as double that of Uranus, giving 38½ units, (2) we might take the next distance as four times that of Uranus, which would give 77 units, or (3) we might take the next distance as double that of Neptune or 60 units, none of these values is good, but (1) is the nearest to what we suppose to be the distance Probably the best course is to assume that after Uranus the law changes, each new distance is then 1½ times the preceding one, on this assumption, the hypothetical planet with distance 100 and period 1000 years would be the next but one after the Lowell planet

The low albedo of the new planet might be explicable if its temperature were much lower than that of Neptune Owing to its smaller size, it would have lost more of its primitive heat, and would only receive half as much from the sun, hence its gases might be reduced to a liquid form, with great reduction of their volume This would result in a relatively smaller disc than the one that might be inferred from its mass

Some further particulars of the discovery are given by the New York correspondent of the *Times* in the issue for Mar 15 Quoting an announcement which had been received there from the Lowell Observatory, it is stated that the planet was discovered on Jan 21 on a plate taken with the Lawrence Lowell telescope, it has since been carefully followed, having been observed photographically by Mr C O Lampland with the large Lowell reflector, and visually with the 24 inch refractor by various members of the staff The observers estimate the distance of the planet from the sun as 45 units, which would give a period of 302 years, and mean annual motion of 1 2 degrees

At discovery, the planet was about a week past opposition, and retrograding at the rate of about 1′ per day, this has now declined to ½′ per day, and the planet will be stationary in April It should be possible to follow it until the middle of May, when the sun will interfere with observation until the autumn

The details of the Lowell Observatory positions have not yet come to hand, when they do, it will be possible to derive sufficiently good elements to deduce ephemerides for preceding years There are many plates that may contain images of the planet, those taken by the late Mr Franklin Adams in his chart of the heavens, those taken of the region round Jupiter some twelve years ago for the positions of the outer satellites, and those taken at Königstuhl and elsewhere in the search for minor planets, these all show objects down to magnitude 15 If early images should be found, they will accelerate the determination of good elements of the new planet, in the case of Uranus, observations were found going back nearly a century before discovery, and in that of Neptune they went back fifty-one years In the present case, forty years is the most that can be hoped for, and probably very few photographs showing objects of magnitude 15 are available before the beginning of this century

One of the most difficult problems will be to find the mass of the new body, in Neptune's case, Lassell discovered the satellite a few months after the planet was found, and the mass was thus determined It is to be feared, however, that the new planet would not have any satellite brighter than magnitude 21 Stars of this magnitude have been photographed with the 100-inch reflector at Mount Wilson, but it is doubtful whether it could be done within a few seconds of arc of a much brighter body Failing the detection of a satellite, the mass can only be deduced from a rediscussion of the residuals of Uranus and Neptune, new tables of these planets will ultimately be called for, but that task must wait until the orbit of the new body is known fairly exactly

The perturbations of Halley's comet will also require revision, at each of the last two returns, there has been a discordance of two or three days between the predicted and observed dates of perihelion passage, it will be interesting to see whether the introduction of the perturbations of the new body effects an improvement The late Mr S A Saunder made the suggestion at the time of the last apparition of the comet that an unknown planet might be the cause of the discordance, but it was not then possible to carry the suggestion further The discovery of a new planet therefore opens a large field of work for mathematical astronomers It will also appeal to students of cosmogony, Sir James Jeans, in an article in the *Observer* for Mar 16, suggests that it may represent the extreme tip of the cigar shaped filament thrown off from the sun by the passage of another star close to it It would have been the first planet to cool down and solidify, he says, "As a consequence of this, it will probably prove to be unattended by satellites"

Lowell's Prediction of a Trans-Neptunian Planet

By Dr J Jackson

THE reported discovery of a planet exterior to Neptune naturally arouses the interest of the general public It will be of importance in theories concerning the genesis of the solar system as to how far it falls into line with the other planets as regards distance, mass, eccentricity and inclination of orbit, and presence or absence of satellites Its physical appearance will be beyond observation To those interested in dynamical astronomy, it may be of some interest to consider the data which led to its discovery and to make some comparison with the corresponding facts relating to Neptune

If the planet which has been reported approximately follows the orbit predicted by Dr Percival Lowell, the prediction and the discovery will demand the highest admiration which we can bestow It is true that the problem as regards its general form is a repetition of that solved by Leverrier, Adams, and Galle more than eighty years ago, but its practical difficulty is of quite a different order of magnitude In short, this discovery, if it turns out to be actually Lowell's predicted planet, was extremely difficult—while Neptune was in fact crying out to be found Let us look at the actual data

Uranus was discovered in 1781 by Herschel Scrutiny of old records showed that it had been observed about a score of times dating back to 1690 The fact that Lemonnier observed it eight times within a month, including four consecutive days, without detecting its character, should be a lesson to anyone who makes observations without examining them In 1820 Bouvard found that the old and the new observations could not be reconciled, and in constructing his tables boldly rejected the early observations, but the tables rapidly went from bad to worse, the residuals amounted to 20″ in 1830, 90″ in 1840, and to 120″ in 1844. Adams used in his first approximation data up to 1840, Leverrier data up to 1845 Now Uranus had passed Neptune in 1822 As the relative motion is about 2° a year, it means that for most of the time covered by the prediscovery observations the perturbations were very small, while from the fact

that the difference between the heliocentric distances is much smaller than expected from Bode's law, the perturbations at the time of conjunction were relatively large Consequently the prediction of the longitude of the disturbing body was very easy, while the determination of the other elements were correspondingly difficult The fact was that the simple hypothesis of the existence of an exterior planet with any sort of guess as to size and shape of orbit would suffice to predict the longitude In other words, most of the residuals could be closely satisfied provided that substantially correct values of the longitude of the planet and its attractive force $m\left(\frac{1}{\Delta^3}-\frac{1}{r^3}\right)$ were used Both Leverrier and Adams easily found values of these quantities, and Galle had no difficulty in detecting the planet

We now turn to Lowell's "Memoir on a Trans Neptunian Planet", published in 1915 The observational basis is the outstanding residuals in the motion of Uranus during two centuries, that is, rather more than two revolutions of that planet round the sun, of somewhat less than two revolutions relative to the predicted planet and of about one relative to Neptune The following are the values of the observed residuals of Leverrier's and of Gaillot's theories taken from Lowell's memoir

	Leverrier	Gaillot		Leverrier	Gaillot
1709		+2 14″	1855		−0 50″
1753	+5 52″	+4 45	1858	+0 50″	−0·20
1769	+4 77	+2 47	1861		−0 36
1783	−3 30	−0 96	1864	+0 25	+0 18
1787	−5 12	−1 20	1867		+1 20
1792	−3 50	+0 10	1870	−0 50	+1 32
1796	−1 88	−0 69	1873		+0 75
1803	+0 40	−1 19	1876	−1 65	−0 50
1812	+2 00	−0 77	1879		+0 58
1817	+0 50	−0 60	1882	−2 88	+0 52
1820	−0 75	−2 37	1885		−0 17
1827	−2 10	+2 00	1888	−4 22	−0 85
1837	−1 10	−1 22	1891		−1 11
1840	+0 63	+0 78	1894	−5 63	−0·50
1843		+0·74	1897		+0 35
1846	+0·38	−1 40	1900	−4 32	+1 00
1849		−0 25	1903	−3 00	+0 65
1852	−1 17	−0 95	1907		+0 25
			1910		+1 10

The residuals show remarkable differences between the two theories, but Lowell deduced that the residuals exceeded their probable errors four or five times The problem was to find from these residuals corrections to the elements of the orbit and to find the mass and the elements of the disturbing body It might almost appear hopeless when we consider that the residuals must be affected by errors in the accepted masses of the known planets There can be no doubt, however, that the masses adopted by Gaillot for Jupiter, Saturn, and Neptune are very accurate Lowell's procedure was to adopt a value of the semimajor axis of the unknown body, and a complete series of values for its longitude, and then select the value of the longitude for which the sum of the squares of the residuals was a minimum The process was repeated with various values of the mean distance until values of the variables were found giving minimum residuals The process was of course very laborious, but Lowell carried it through with great perseverance The following extract from his final summary may be quoted "By the most rigorous method, that of least squares throughout, taking the perturbative action through the first powers of the eccentricities, the outstanding squares of the residuals from 1750 to 1903 have been reduced 71 per cent by the admission of an outside disturbing body"

The inclusion of further terms, of additional years and of the squares of the eccentricity, do not alter the results by any substantial amount Lowell considered that the remaining irregularities could be explained by errors of observation No trustworthy results could be found from the residuals in latitude so that the inclination of the orbit to the ecliptic could not be deduced, but Lowell considered that it might be of the order of 10°

As the solution really depends on the difference of the attraction of the unknown planet on Uranus and on the sun, there are two possible solutions in which the longitudes differ by about 180° The following elements are for the solution satisfying most nearly the position of the newly found body

Heliocentric longitude on 1914, July	84 0°
Semimajor axis	43 0
Mass in terms of the sun's mass	1/50,000
Eccentricity	0 202
Longitude of perihelion	203 8°

This gives the longitude at the present time as about 104° compared with 107° of the new planet The predicted magnitude was 12 to 13 or about ten times brighter than the observed, and a disc of more than 1″ was predicted This is a rather serious discordance

The smallness of the residuals indicated that the forces were small The mass given above is only 0 4 of the mass of Neptune At mean conjunction, the attraction of the predicted planet on Uranus would be only one-fifteenth of the attraction of Neptune in a similar position, and in addition it would last for a shorter time on account of the more rapid relative motion

The discovery of a minor planet of the fifteenth magnitude is an everyday occurrence The planet reveals itself by a decided motion relative to the stars in the course of taking a photograph For a planet in the predicted orbit, the motion shown (mostly due to the earth's motion) would in the most favourable circumstances not be more than 2″ or 3″ an hour, and it would probably need a trail of at least 5″ for the planet to be detected On the other hand, photographs taken on successive days would show decided motion, but the labour of finding the planet in a region containing many thousands of stars from separate photographs would be very great Probably the Lowell observers have come across several minor planets before they were rewarded by the discovery of the very distant planet.

Astronomers all the world over will naturally look forward with great interest to see how nearly the newly discovered body moves in the orbit predicted by Lowell, and are anxiously waiting for further details of the observations.

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No 3151 MARCH 22, 1930

Atomic Physics and Related Subjects

COMMUNICATIONS TO *NATURE*

The Problem of Stellar Luminosity

SIR JOSEPH LARMOR, who raised certain interesting points concerning the validity of my recent work on stellar luminosity in NATURE of Feb 22, has kindly allowed me to see some further exposition on these points which he proposes to publish in the *Observatory* With his further analysis of the situation I am in complete agreement As regards the question which he thinks still outstanding, the work of Sir James Jeans and of J Woltjer, together with my own investigations, shows that $1-\beta$, the ratio of radiation pressure to total pressure varies very slowly in the photospheric layers of a star on plausible assumptions as to the absorption coefficient It therefore satisfies his requirement of being independent of the precise surface at which it is evaluated But it is necessary to explain the discrepancy with other existing theories

All formulæ so far given for the luminosity of a star are cooling formulæ They take different forms according to the data Thus given the radius r_1 and the actual temperature T_1 of the photosphere, the cooling L is at the rate $4\pi r_1^2\sigma T_1^4$ Given the mass M, the relative density distribution, the surface opacity and T_1, we have the formula given in my paper (p 38) which is due in principle to H Vogt Given the mass, the relative source distribution, and the internal opacity, we have a formula due to Prof Eddington, which he has transformed into forms involving T_c (the central temperature) and T_e (the effective temperature) The problem is, however, something much more deep seated than a mere cooling problem The complete solution of the problem would predict the luminosity of a given mass M when in a steady state, given simply the physical properties of the matter composing it, without any other astronomical data This problem is so far completely unsolved Though Prof Eddington has pictured the astronomer on the cloud bound planet as being capable of predicting the luminosities of the unseen stars, he would in fact be completely incapable of predicting them at all, for he would not have the slightest idea as to what to expect for their effective temperatures, and the effective temperature is an additional astronomical datum which requires to be given before Eddington's formulæ become applicable The cloud bound astronomer would be quite incapable of foretelling the observed mass luminosity relation—the confining of the stars to a narrow band in the plot of luminosity against mass

When we attempt to probe more deeply into the problem of stellar luminosity and effective temperature, using Eddington's theory as a basis, we encounter difficulties so serious that in my opinion they can only be removed by abandoning one feature of Eddington's method of approach That theory makes luminosity 'depend' on interior opacity But how can the opacity (a property depending on outer electronic configuration) affect the unknown subatomic generation of energy? According to his formulæ, if we change the opacity we change the luminosity But the only way in which opacity can have a physical effect is by altering the internal temperature, and thus it would appear that the theory involves a specific dependence of rate of generation of energy on temperature, whereas no such dependence has been explicitly woven into the theory No formula is given which determines the (effective or central) temperature of a given mass in terms of purely physical (that is, non astronomical) data Eddington's equations are incomplete They are one short The missing equation is easily supplied It is $L=\int\epsilon dM$, where ϵ is the rate of generation of energy per unit mass The satisfaction of this condition is not automatically provided for in Eddington's scheme of equations

The internal contradictions that arise may be illustrated as follows It is stated that his special model is most accurate (on the physical theory of opacity) when the generation of energy is proportional to the temperature T at any point Put then $\epsilon=\lambda T$ Either λ depends solely on the physical properties of matter and is then an atomic constant, or it depends on the past history of the material Consider first the former alternative It gives $L=\lambda\int TdM=\lambda M\bar{T}=\lambda M\times 0\,584T_c$ Combining with Eddington's formula $L=\text{const}\times M(1-\beta)^2\beta^{-1}T_c^{\frac{1}{2}}$, we find $T_c=\text{const}\times(1-\beta)^4\beta^{-2}$ where the first factor is a purely physical constant This would make T_c an increasing function of mass, contradicting the 'observed' constancy of T_e along the main series Combining this again with his formula $T_e\propto M^{-\frac{1}{4}}(1-\beta)^{-\frac{1}{4}}T_c^{\frac{1}{2}}$ where T_e is the effective temperature, we find $T_e^{\frac{1}{2}}\propto M(1-\beta)\beta^{2}$ This makes T_e an increasing function of mass, contradicting the simultaneous existence of giants and dwarfs of widely different mass but the same effective temperature (Any formula of the type $\epsilon=\lambda\rho^a T^b$ will be found to lead to a similar contradiction)

We are then driven back on the second alternative, that λ depends on the past history of the material and so may be different for different stars This is the 'exhaustion effect' But now the exhausted material may distribute itself in any way through the non exhausted energy generating material There will in general be a concentration gradient of the latter with respect to the former through the star, and though $\epsilon=\lambda T$ may describe the nature of the concentration gradient, this no longer implies a physical dependence of ϵ on temperature The energy generating material may even generate energy at a rate independent of temperature, and be simply distributed through the 'dead' material so as to mimic the distribution $\epsilon=\lambda T$ We are now compelled, since a hard and fast dependence of ϵ on T and ρ is ruled out, to consider the other extreme, the 'uranium' model of Jeans, with local energy generation independent of temperature (or of course any intermediate model) But the problem cannot now be studied by Eddington's method This method *begins* with the relative source distribution (his η) The problem now becomes given a mixture of x grams of uranium (or other radioactive material)

and y grams of calcium (or other 'dead' material), How do the x grams of uranium distribute themselves through the y grams of calcium? The relative source distribution, which in Eddington's analysis is a datum of the problem, now becomes an unknown which has to be determined The luminosity, in Eddington's analysis an unknown, becomes a datum

According to his "Internal Constitution of the Stars", Eddington would meet this difficulty in two ways He contends first that the uranium model is unstable, secondly that the luminosity (for equilibrium) is roughly independent of the source distribution η The following considerations show that neither of these contentions can be accepted In the first place, he argues that if the total rate of generation L' falls below the rate of cooling L, the star will contract indefinitely (p 303), since according to him L increases as the star contracts But, as pointed out by Jeans, this involves the assumption that a formula derived for a special model in equilibrium holds generally Physically a star cannot 'contract indefinitely' It cannot *vanish* Physical intuition of the valid kind tells us that sooner or later the star must find a (contracted) configuration of equilibrium, each element, being supplied with energy at a rate less than its momentary rate of cooling, must cool until the two balance, the energy it gains from compression will simply enable it the sooner to arrive at this state A cooling element cannot cool at an increasing rate as it cools

Similar considerations show that the luminosity of a star cannot be even roughly independent of the relative distribution of energy sources, when we consider the distribution as a datum and the luminosity as a dependent variable Eddington has offered as proof of his contention a special solution of the point source model But given a point source model, of luminosity L_1, we can always derive another of the same mass and of arbitrarily smaller luminosity L_2 If we simply reduce the strength of the internal point-source, the star can only contract on itself, and hence as above find a new configuration of equilibrium Counting up of arbitrary constants in the fundamental differential equation for a point source model shows that the model (for given mass and luminosity) has in fact an additional degree of freedom, after arbitrarily choosing L (less than some upper limit) and the mass M, we can arbitrarily fix the radius, that is, arbitrarily fix the effective temperature (I owe this to discussions with Mr T G Cowling) Thus we can find point source models of given effective temperatures and *any* luminosity

Again, take any one model, of luminosity L and mass M, with any particular source distribution Arbitrarily diminish the intensity of the sources The star can only contract It contracts either slightly or catastrophically In the latter case the original model is unstable, but it must sooner or later arrive at a new equilibrium configuration In either case we arrive at a state of arbitrarily smaller luminosity and the same mass, and this altered state will possess some definite source distribution to correspond

In Eddington's method of approach the energy-sources may be considered as a population of taps, of given relative concentration towards the centre, but capable of being turned on to any amount that may be required It is then shown that the concentration by itself alone determines the amount they would have to be turned on for a steady state But we have no guarantee that in the model thus constructed the physical conditions of the material at each neighbourhood will be in fact such as to turn them on to the required amount For example, the surviving degree of adjustment by means of temperature alone leads, as we have seen, to a contradiction with observation In the uranium type of problem, with absolute rate of generation, we cannot *begin* with a given population-concentration, we have to find it—to find the concentration gradient of the solution of uranium in calcium from centre to boundary necessary for a steady state

By considering an unrestricted range of relative *density* distributions consistent with a *given* luminosity and a given mass, I have shown in *Mon Not R A S*, Nov 1929, that the solution of the uranium problem by equilibrium considerations only is not unique, there are an infinite number of different relative density distributions possible, all compatible with a given L and M, specified by a certain function ϕ The observed effective temperatures occurring in Nature restrict the forms of the ϕ's to those possessing a certain property described by giving a definite numerical value to a dependent quantity C The question is, What are the physical considerations restricting ϕ?

I need scarcely say that, while advancing these more elastic theories, I am deeply sensible of the services which Prof Eddington's investigations have rendered to the study of stellar structure

E A Milne

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Mar 5

The Growing Importance of Frequency

The relation between energy and mass, $e = mc^2$, where c is numerically the velocity of light, indicates that energy has mass and that mass has energy, furthermore, it suggests that the conservation of mass of the chemists *is* at *one* with the *conservation* of energy of the physicists This relation appears more emphatic if we so alter the unit, either of mass or of energy, that the constant c^2 becomes superfluous, and we write in consequence $E = M$ This would be correct, for example, if our new unit of energy were 9×10^{20} ergs We do not therefore state that energy is necessarily matter, but we do state that the same abstract number will express matter in terms of energy, or energy in terms of mass We must always be careful not to confuse, say, sheep and oxen, because we happen to see the same number of these different animals

It is remarkable that transfers of energy take place in quanta of value hf, where f is frequency and h is Planck's constant We can again alter our unit of energy, or our unit of time, in such a manner that h is superfluous, and the relation $e = hf$ becomes $E = F$, and this indicates that energy and frequency can be expressed by the same abstract number, so that a *conservation of energy has its counterpart in a conservation of frequency* Thus in place of the linkages of Nature, to which we are growing accustomed, such as

$$e = mc^2 = hf = Jq,$$

we can, by adopting what I venture to call super-units, write down

$$E = M = F = Q,$$

wherein energy, mass, frequency, and heat appear all expressed with the same abstract number We are not unfamiliar with this Energy is expressed sometimes in ergs, at other times in equivalent calories, or even in volt-electrons

It is the purpose of this note to urge a status for frequency comparable with that of its older brethren, if, indeed, we are not recalling the music of the spheres to a fresh harmony

Again, the Einstein Bohr equation

$$h\nu = W_1 - W_2$$

can be written

$$h\nu = hf_1 - hf_2,$$

or more simply

$$\nu = f_1 - f_2,$$

which expresses clearly the beat or heterodyne character of the observable frequency ν derived from two unobserved or unobservable frequencies f_1, f_2 characteristic of the atom, due to the necessity of standing waves or 'repeat patterns' of the electronic waves in their passage around the nucleus

So, too, the Einstein transformation equation

$$T = (t - vx/c^2)/\sqrt{1 - v^2/c^2}$$

may refer to a particle moving with velocity v relatively to an observer Now this equation, as de Broglie pointed out, involves another velocity u, which may be denoted by c^2/v and is greater than the velocity of light

It may be thought of as a phase velocity, of which v may be shown to be the group velocity In the case of a mass m, moving with velocity v, if we state

$$h\nu = mc^2$$

$$c^2 = uv$$

$$u = \lambda\nu$$

and multiply the left sides together, and the right sides, and equate, we have after cancelling

$$\lambda = h/mv$$

This is the precise relation which Davisson and Germer, and G P Thomson, have shown to hold for an electron Thus the frequencies of waves seem to be achieving a remarkably fundamental rôle, comparable with that of energy Waves of what? The key to the central tower of physics has yet to be found No less obscure is the connexion between the two different types of electric charge and their attendant waves The linkage between energy and time, which resembles that between p and q in Dirac's equations, also suggests a close relationship between energy and frequency

A S Eve

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A Cosmological Conjecture

According to quantum mechanics, a harmonic oscillator of frequency ν has a lowest energy state the energy of which is $\frac{1}{2}h\nu$ When the electromagnetic field is treated, after Rayleigh and Jeans, and Debye, as an assemblage of independent harmonic oscillators, one of which is associated with each of the normal modes of vibration of the ether, this leads to the result that there is present in all space an infinite positive energy density It is infinite because there is supposed to be no upper limit to the frequencies of possible normal modes

According to Dirac's theory of the proton (*Proc Roy Soc*, A, January 1930) there is an infinite negative energy density associated with an infinite number per unit volume of relativistic electrons in negative energy states Moreover, since the electrons are handled as a wave phenomenon, for great negative energies the number of states in unit energy range presumably is the same function of the energy as the number of normal modes for the ether is of the frequency

It is, therefore, a natural conjecture to suppose that these two infinite energy densities just cancel each other If they do, it indicates a certain artificiality in our present theories and points to the possibility that radiation and the electromagnetic field may be assimilated into a unified theory which regards them, like the protons, as another aspect of the negative energy electrons In such a theory, these two infinite energy densities would be balanced off at the outset and so would never appear

We refrain from calling our conjecture a theory in deference to the views of Prof H E Armstrong recently expressed in these columns

E U Condon

J E Mack

(National Research Fellow)

University of Minnesota,

Minneapolis, Feb 14

Unimolecular Films

The changes of state occurring in unimolecular films were the subject of a recent investigation (Lyons and Rideal, *Proc Roy Soc*, **124**, A, 322, 1929) It was concluded, following Muller (*Proc Roy Soc*, **114**, A, 542, 1927), that the molecules in the film were generally tilted The suggestion was made that in the solid films of long chain substances the tilt of the molecules and therefore their areas were determined by the interlocking of zigzag chains Since these views have recently been criticised (Adam, *Proc Roy Soc*, **126**, A, 526, 1930), owing partly to a misunderstanding, a recapitulation of them and the evidence in their favour seems desirable

The hypothesis of interlocking chains applies to *solid* films These may be considered as consisting of unimolecular 'crystalline' sheets The hypothesis requires that long chain substances with small asymmetric polar head groups should give such films (where the chains have lost their flexibility) with one of two limiting areas, namely, 20 6 sq A and 26 2 sq A per molecule Clearly, substances with bulky substituents in the chain and those containing the large disc like aromatic nucleus cannot be used to test this suggestion

The smaller area is given by a very large number of compounds, but the larger area, as is to be anticipated, is only obtained in a few instances, and its validity has been questioned on both the experimental and theoretical sides

The results of Adam and ourselves on the amines and their hydrochlorides show that the films of these materials are more complex than was suspected previously A more detailed investigation is now being made, the results of which will be published on completion of the work However, it may be stated that the solid films of heptadecylamine have been obtained both with areas of 20 6 sq A per molecule and 26 2 sq A depending on the conditions The amine hydrochlorides (with which most of Adam's work was carried out) have yielded as yet only areas of 20 5 sq A per molecule in agreement with his values The variations in area seem to be due to a fundamental property of the system and may possibly be due to a dimorphism as for the ureas (v inf) The X ray data on amine hydrochlorides (Bragg, Solvay Congress Rep, 1925, 36) show corresponding anomalies which were also attributed to polymorphism

The criticism on the theoretical side was chiefly concerned with the properties of the ureas

The long chain ureas give an area of 26 2 sq A per molecule below a certain temperature, above which they give 20 5 sq A It was suggested that the sharpness of the transition, which occurs over a very narrow temperature range, is inconsistent with the hypothesis of interlocking chains We consider that this sharpness is to be expected, for probably the change is due to a true transition between two distinct crystalline states This is an example of

dimorphism in two dimensions which is comparable with that of rhombic and monoclinic sulphur in three dimensions

The increase of chain length affects the transition temperature in a similar manner to its effect on many other physical properties

The existence of solid films with areas of 26 2 sq A per molecule does, therefore, support the hypo thesis of interlocking chains

A further criticism has been brought that some films which have areas corresponding with the interlocking position may not be solid There is, however, no sensitive process for distinguishing between a viscous liquid and a weak solid film The ordinary method of blowing dust particles on the surface may give very doubtful results in border-line cases, since the pressures generated by blowing, although apparently small, may have a profound influence on a thin unimolecular film The monoglyceride films of area 26 2 sq A per molecule for which "dust on the surface obviously does not move very easily" (Adam, *Proc Roy Soc*, **117**, A, 532, 1928) are examples of such border line cases Here a more delicate technique is needed to establish their physical state without ambiguity

Nevertheless, it is clear that films with an area per molecule slightly larger than that calculated for interlocking may be liquid These films are very likely to be obtained when the angle of free tilt is close to the interlocking angle The liquid alcohols fulfil these requirements, and the available evidence suggests that the area per molecule is slightly greater than that found for fatty acids (Adam and Dyer, *Proc Roy Soc*, **106**, A, 694, 1924)

Further misconception has arisen from the bearing of this hypothesis on the results of X ray analyses of crystals of long chain compounds Interlocking should give rise to one of a series of calculable tilts The principle seems to apply there, at least to a first approximation It must, however, be remembered that the crystal is of a much more complicated structure, and disturbing influences are much more likely there than in a thin film (cf Muller, *Proc Roy Soc*, **124**, A, 317, 1929, on the mutual influence of the polar groups of the molecules forming the bimolecular layers of the crystal)

In conclusion, it may be stated that all the ali phatic compounds yet examined by X ray methods consist of plane zigzag chains The areas of films calculated for the interlocking positions do not depend on one analysis alone, but are based on the collected results for these different substances, and in particular on the accurate and detailed analysis of stearic acid and the hydrocarbons (Muller, *Proc Roy Soc*, **114**, A, 542, 1927, **120**, A, 437, 1928) which are in such excellent agreement

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Structure of Naphthalene and Anthracene

IN a paper published in the *Proceedings of the Royal Society* (vol A, 125, p 542, 1929) on the structure of naphthalene and anthracene, J M Robertson comes to the conclusion that "the scattering centres lie nearer the *ac* planes than the *bc* planes, but no simple structure with a plane of symmetry parallel to the *ac* plane is possible", and that the scattering centres lie along a chain structure similar to hydro carbons On the other hand, the structure of hexa methylbenzene as determined by K Lonsdale (*Proc Roy. Soc.*, vol. 123, p 537, 1929) suggests that the benzene rings in aromatic compounds should in all probability be plane structure This has further support from the plane hexagonal structure of graphite (Ott, *Ann d Phys*, vol 85, p 81, 1928) As regards whether the scattering centres are nearer the *ac* plane or the *bc* plane, the optical and magnetic anisotropies which have been measured by S Bhaga vantam (*Proc Roy Soc*, vol A, 124, p 545, 1929) require that the carbon atoms should lie nearer the *bc* plane than the *ac* plane The structure proposed by Robertson, however, does not explain the in tensities of reflection from many of the crystal planes, which he supposes are due to small glancing angles for those particular reflections But on evaluating the angle factors for the intensities it is seen that such large discrepancies cannot be explained in that manner

I made an X ray investigation into the structure of naphthalene and anthracene, the results of which will be published shortly It has been found that the best agreement for the intensities of reflections from these crystals is obtained when all the carbon atoms in one molecule are supposed to be in one plane and the planes of the molecules are inclined to the cell faces The correct positions of the molecules are obtained by first placing them along the *bc* planes, then rotating them through 25° about the *c* axis (the two molecules in the unit cell being rotated in opposite directions), and then rotating them about *b* axes through 12° and 9° for naphthalene and anthra cene respectively The agreement will be best seen by referring to the table appended herewith, where the results for some simple planes are given Similar agreements were obtained for all the forty planes from which reflections were observed It can be easily seen that agreements are much better than those obtained by Robertson

TABLE I

Indices	Naphthalene		Anthracene	
	Theoretical Structure Factor	Experimental Structure Factor	Theoretical Structure Factor	Experimental Structure Factor
001	15 3	15 3	13 2	13 2
002	6 0	6 2	8 8	8 4
110	18 2	17 5	27 0	30 3
11$\bar{1}$	5 1	5 9	10 2	8 9
020	6 6	7 0	8 3	7 5
200	15 0	14 8	19 8	18 3
20$\bar{1}$	24 8	23 0	21 0	14 9
20$\bar{2}$	5 2	4 8	9 2	9 9
210	10 0	10 6	14 7	16 2
21$\bar{1}$	9 2	10 0	12 6	14 9

The intensities of 007, 20$\bar{7}$, 40$\bar{7}$, 607 reflections from naphthalene and 00$\bar{9}$, 209, 40$\bar{9}$, 609 reflections from anthracene, on which Robertson bases his arguments for supposing that the scattering centres lie nearer the *ac* planes, agree qualitatively with experiment as the structure factors for the 407 and 40$\bar{9}$ planes respectively come out the highest among the series according to this arrangement of placing the carbon atoms

KEDAVESWAR BANERJEE
210 Bowbazar Street,
Calcutta, Nov 26, 1929

I BELIEVE Dr Banerjee's structure to be essentially correct It has been clear to me for some time that the last two sections of my paper to which Dr Banerjee refers must be amended as regards the distribution of the scattering centres in the *a* and *b* directions During last summer, Sir William Bragg made 'abso

lute' measurements of the intensities of the reflections from a number of anthracene planes These measurements were expressed as ratios between the structure factors actually found, and the structure factor to be expected if all the atoms were in the reflecting planes It was intended that these results and deductions therefrom should be incorporated with my paper, the publication of which was to be delayed for the purpose unfortunately, owing to my absence from England, there was some confusion during the revision of the proofs and this was not done Sir William Bragg's figures lead to a structure resembling Dr Banerjee's so closely that it is interesting to give the following quotation from a letter which he wrote to me It is in the form of notes upon a table of structure factors

No 1 "A flat molecule, axis along the *c* axis, plane of molecule making an angle of 25° with the *bc* plane This gives good values in the *c* zone, but not in the *b* zone, especially the $20\bar{1}$ is far too weak So next (No 2) the molecule is tipped over a little more to the upright position (about 6°) This greatly improves the *b* zone In No 3 a slight buckle is put in, to try to improve the notable 204 The consequences are not very striking On the whole there is so much agreement that we cannot be very far wrong"

Plane	S Observed	S Calculated		
		No 1	No 2	No 3
200	0 70	0 68	0 58	0 60
020	0 33	0 32	0 32	0 31
110	0 50	0 47	0 48	0 47
210	0 67	0 58	0 52	0 55
310	0 20	0 23	0 19	0 17
410	0 55	0 67	0 39	0 29
320	0 50	0 55	0 40	0 42
001	0 22			0 23
002	0 26		0 19	0 15
$20\bar{1}$	0 50	0 14	0 43	0 40
204	0 80	0 27	0 50	0 73

Whether the carbon atoms in these molecules lie in one plane as strictly as do the graphite carbon atoms, or those of hexamethylbenzene, can scarcely yet be stated with certainty But the structure certainly appears to approximate to those types

J M Robertson
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The Crystal Structure of Xenon

Of the rare gases, argon is the only one of which the crystal structure is known (F Simon and V Simson, *Zeit f Phys*, **25**, 160, 1924) We have now been able to determine the crystal structure of xenon by a method allowing the use of a very small quantity of gas it was condensed as a very thin layer upon the surface of a quartz capillary internally cooled by liquid air The thickness of the condensed layer can be estimated to be about 0 004 cm

We obtained very good photograms by the powder method, using a Philips tube fitted with iron anticathode in less than 2½ hours exposure From the photograms, consisting of sixteen lines, three of which correspond to the $K\beta$ radiation of iron, we have been able to establish that xenon, like argon, shows a face centred cubic structure

The lattice constant of the elementary cell, consisting of four atoms, is $a = 6\ 18 \pm 0\ 01$ A the volume is $236\ 03 \times 10^{-24}$ c c and the calculated density, taking as the weight of the hydrogen atom $1\ 65 \times 10^{-24}$ gm, is $d = 3\ 64$ gm /c c (The density of liquid xenon at the boiling point is 3 06 (Ramsay and Travers)) From the previous data the atomic radius of xenon can be calculated as 2 18 A The atomic radius calculated from gaseous viscosity measurements (A G Nasini and C Rossi, *Gazzetta*, **58**, 433, 1928) is 1 70 A, thus being smaller than the crystal structure datum we may point out, however, that the two figures bear the same ratio as for argon The radius calculated from the present measurements is very similar to those, calculated by Goldschmidt, of the positive ions monovalent iodine, divalent tellurium, and tetravalent tin, having the same number of external electrons (Geoch Verteilungsgesetz d Elem, *Norske Vidensk Akad*, Oslo, **7**, 54, 1926)

We are now examining the crystal structure of krypton, but a modification of the present apparatus will be necessary, since the vapour pressure of krypton, at the temperature reached as above, is somewhat too high A more detailed account of the present research and of the work on krypton will appear elsewhere

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Behaviour of Electrons in a Gas Tube

The late Mr Campbell Swinton observed (*Proc Roy Soc*, **61**, 79 1897) that a carbon anticathode in a gas X ray tube under certain conditions showed a ring of fluorescence which he considered due to the hollow nature of the cathode stream The following preliminary account of some experiments with a gas X ray tube of the Shearer type shows that the effect can be more complex than is usually suspected

The anticathode end of a Shearer tube was replaced by a brass tube of approximately the same length and

Fig 1

diameter The tube was waxed in the usual way to the glass cylinder of the X ray tube and was sealed at the other end by a glass plate so that the luminescence due to the electron stream from the cathode could be viewed end on

It is found that the glass fluoresces in a very striking manner At a pressure just greater than that at which the tube would normally be worked when producing X rays, two bright concentric rings appear The outer one is rather diffuse, the inner is remarkably sharp As the pressure is decreased the inner ring subdivides into others equally well defined, and later, a bright point of fluorescence appears at the centre of the rings accompanied by intense local heating of the glass and the production of X rays The tension applied to the tube was of the order of 10,000 volts, and the effect observed was the same whether the

current was alternating or rectified An increase in voltage seems merely to intensify the rings and to result in their further subdivision That the rings are caused by electrons is shown by the fact that they can be moved by a magnet That they do not occur at different moments of a single discharge cycle can be shown by viewing them in a rotating mirror

The accompanying photograph (Fig 1) was taken at an angle of about 45° to the glass plate so as to avoid the general illumination inside the tube and clearly illustrates the multiple ring formation

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The Diffraction of X-Rays by Vitreous Solids and its Bearing on their Constitution

The diffraction of X rays by glasses has been the subject of many investigations during the last fifteen years, notably by Scherrer, Wyckoff, and Seljakow Scherrer obtained broad diffraction bands similar to those obtained with liquids, whilst Wyckoff obtained, in general, more complicated patterns consisting of lines, bands, or lines superimposed on bands The latest contributors to this subject are Parmelee, Clark, and Badger (*Jour Soc Glass Technology*, 13, 285, 1929), and Clark and Amberg (*ibid*, p 290), who have also obtained broad diffraction bands for silica and felspar glasses Quite apart from the validity of any of these measurements, no previous workers appear definitely to have identified the diffraction bands with small crystallites in the glass

With the view of obtaining more precise data on the constitution of glasses we have recently examined the diffraction effects produced by passing copper $K\alpha$ radiation through silica, wollastonite, sodium borate, potassium borate, boric oxide, selenium, potash and soda felspars, glucose and sucrose, in the glassy state Results have also been obtained with the more usual soda-lime-silica and boro silicate glasses

We have been able to show that silica glass corresponds to either cristobalite or tridymite crystallites, of average size 1 5 2 0 × 10^{-7} cm, with the evidence very much in favour of cristobalite Also we have shown that wollastonite ($CaSiO_3$) glass corresponds to the crystalline pseudo wollastonite and that sodium borate $Na_2B_4O_7$ corresponds to crystals of this substance

In the case of potash felspar (K_2O Al_2O_3 $6SiO_2$), it has been found that the crystallites of the glass are mainly silica (probably cristobalite) The identity of the remainder is as yet uncertain Boro silicate glass containing 70 per cent SiO_2, 17 per cent B_2O_3, and other substances in minor proportions gives a very similar band It has been found, in further confirmation of the observations, that potash felspar glass devitrifies to cristobalite and that wollastonite glass, which, it is to be expected, is much more stable, devitrifies to crystalline wollastonite at 900° C

We are not in agreement with the observations of Parmelee, Clark, and co workers on the positions and number of bands obtained with fused silica and with felspar glass We obtained for fused silica one band with a spacing of 4 33 A, whereas they obtained two bands, one at 7 1 A, and a faint one at 2 5 A Our work was carried out with copper $K\alpha$ radiation, whereas they worked with the radiation from a molybdenum target We have repeated our measurements with molybdenum $K\alpha$ radiation, and again obtain the strong band at 4 33 A, together with a faint and much more diffuse band at about 1 5 A For equal distances of specimen from film the breadth of a band when using copper $K\alpha$ is roughly twice that with molybdenum $K\alpha$, so that failure to detect the faint band with copper $K\alpha$ may have been due to this cause We have tested out this point and have failed to obtain the second band using copper $K\alpha$ radiation with the distance from specimen to film reduced by more than half It seems probable, therefore, that the faint band obtained with molybdenum $K\alpha$ radiation is spurious and that the only one on which reliance can be placed is that at 4 33 A We have checked this spacing with those of standard substances obtained on the same apparatus and are unable to understand the value of 7 1 A given by Parmelee and Clark We hope shortly to publish these results elsewhere in greater detail

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H P Rooksby,
B S Cooper

Research Laboratories of the
General Electric Company, Ltd,
Wembley, Mar 1

Scattering of Electrons and α-Particles.

Experiments by Rutherford show anomalies in the scattering of α particles in a certain range of velocities for light elements Similarly, the scattering of electrons by atoms shows anomalies for small velocities, as was discovered by Ramsauer Both effects can be treated in a similar way by wave-mechanics considerations

Let us first consider the corresponding one dimensional problem A particle is reflected (scattered) from a potential valley When the valley has the simple form of a rectangle, the effect can be treated as the well known phenomenon of interference from thin plates in optics For certain velocities (frequencies) no particles (light) are reflected, for other velocities the coefficient of reflection has a maximum This is not limited to a rectangular shape but occurs for very general potential valleys

In the three dimensional case, particles which are treated as a plane wave are scattered by an atom or by a nucleus, which is assumed to possess spherical symmetry This plane wave may be enveloped into a series of spherical harmonics [1] For each component one obtains a scattering coefficient, which is an oscillating function of the velocity of the incident particles

In the first approximation the atom can be considered as a potential valley, which can be determined by the methods of Hartree A nucleus should also be treated in this approximation as a potential valley, as was pointed out by Gamow in his theory of radio active disintegration

For electrons of sufficiently small velocities, only the zero order scattering is appreciable The minimum of the zero order scattering explains the Ramsauer effect [2] Something similar is true when an α particle hits a nucleus with a velocity which is high enough so that it passes over the potential wall separating the inside of the nucleus from the outer space For certain velocities of the incident particles the scattering coefficients of low order are affected a great deal by the presence of the potential valley. The resulting modification of the Rutherford scattering law has been calculated and reproduces the general type of experimental curves Quantitative agreement cannot be expected until the shape of the potential valley of the nucleus is known in detail

The detailed presentation will be given in an article to appear in the *Zeitschrift für Physik*

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[1] H Faxén and J Holtsmark, *Zeit f Physik*, vol 45, p. 307; 1927
[2] J Holtsmark, *Zeit f Physik*, vol 48, p 231, 1928 vol 52, p 485, 1929

Scattering of α-Particles by Light Atoms

In a letter to Nature of Feb 1, and in greater detail in the *Philosophical Magazine*, vol 9, No 56, February 1930, Prof A C Banerji has discussed some wave mechanical calculations on the scattering of α particles by light atoms I should like to make some remarks on this problem, which I have treated in a paper to appear in the *Zeitschrift für Physik*

The first remark refers to the choice of nuclear model While Prof Banerji has assumed a central field of force consisting of a repulsion proportional to the inverse cube of the distance to be added to the Coulomb field due to the nuclear charge, I have taken a model corresponding to that used by Gamow to explain the radioactive decay, that is, for distances r larger than the 'radius' r_0 of the nucleus, the potential is supposed to be Coulombian and for $r<r_0$ a constant V_0 The scattering calculated by the mathematical method due to Born shows all the characteristic deviations from the normal Rutherford scattering, which have been traced experimentally by Bieler, Rutherford, and Chadwick

We cannot expect that this very rough model should give quantitatively right results, but if we determine r_0 and V_0 so as to give the experimentally measured scattering for small angles, we obtain a first rough approximation to the potential in the nucleus For aluminium we get for r_0 the value 2 23 × 10^{-13} cm, and for magnesium a somewhat smaller value, in agreement with the general increase of nuclear dimensions with atomic number In contrast with this, Prof Banerji, who also defines a 'radius' r_0, gets a larger value for magnesium than for aluminium Besides, there is the difference that our r_0 does not depend on the velocity of the incident α-particle

The above mentioned scattering formulæ contains the velocity v of the α particle and the scattering angle θ only in the connexion $v \sin \theta/2$, therefore if v and θ are varied so that $v \sin \theta/2$ is constant, the scattering will remain the same This gives a very simple displacement rule which allows us to calculate the scattering for every v and θ if the scattering is known for one value of v and all values of θ, or for one value of θ and all values of v

It can be shown that this displacement rule, which seems to be in good agreement with experiments, holds for every nuclear potential of central symmetry if we confine ourselves to the first approximation of the Born method That this is legitimate is not quite obvious, since the first approximation is not everywhere small compared with the zero approximation For $r=0$ the two approximations are, for example, of the same order of magnitude Also Prof Banerji confines himself to the first approximation of the Born method, and for his potential this approximation is even infinite in the origin

The next problem is how to improve the very rough assumptions about the potential within the nucleus For this purpose I have considered the following unclear model Let r_0, r_1, r_2, r_n be a sequence of numbers so that $r_p>r_{p+1}$ ($p=0$, 1, 2, n) For $r>r_0$ the potential is again supposed to be Coulombian Inside the shell $r_p>r>r_{p+1}$ it is supposed to have the constant value $V_p(p=0, 1, n)$ The Born method gives again a very simple expression for the scattering by this model This expression contains the constants r_0, r_1, r_n and V_0, V_1, V_n From the experimental scattering curves it will be easy to determine the constants V_p when the r_p's are arbitrarily given, that is, we have a general method from the experimental data to determine the potential in the nucleus with any desired accuracy The performance of this work demands, however, more accurate measurements than are yet at hand

It should also be remarked that according to our formulæ the sensitivity of such determination of the nuclear potential will decrease for decreasing distances from the centre Indeed, the influence of a change of the potential on the scattering result will vanish for distances very small compared with the de Broglie wave length of the incident α particle

Added in Proof—In the issue of *Die Naturwissenschaften* of Mar 14, Mr Th Sexl has treated the problem of the scattering of α particles from a point of view similar to that of Prof Banerji In addition, he has also considered the case of an attractive force, which varies with the inverse fourth and fifth power of the distance The last case corresponds with the idea proposed by Debye and Hardmeier, that the anomalous scattering should be sought in the polarisation of the nucleus produced by the α particle As the agreement with the experimental results in none of the cases investigated by him is quite satisfactory, Mr Sexl infers that a nuclear polarisation is insufficient to explain the results, and that some other effect must be looked for

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Feb 21

Electron Affinities of the Elements

The various attempts to find experimentally the electron affinities of the chemical elements have met so far with little success Since such a determination would probably help in shedding light on chemical reactions and the formation of molecules, it is obviously important Accordingly, a method is here outlined which enables one to say approximately which elements have a positive electron affinity, and also to predict the approximate position of whatever lines of the electron affinity spectrum occur

By definition, the electron affinity of an atom is the ionisation potential of its negative ion, or the difference in energy between the normal state of the atom and the normal state of the ion From the work of Bowen and Millikan and others on stripped atoms, many of the higher ionisation potentials are known In the iso electronic sequence Be^{++}, Li^{+}, He, H^{-}, the ionisation potentials of the first three are known, and so we may extrapolate to get that of the fourth This would be our method of estimating the electron affinity of the hydrogen atom In this case, one must make a long extrapolation (from 24 47 volts), and so the attainable accuracy is not extremely high Assuming that the square root of the ionisation potential is linear in Z, the atomic number which gives reasonable agreement with the experimental values, one finds the electron affinity of H to be 1 4 volts Other methods of extrapolation may yield somewhat lower values This is in agreement with theoretical work of Bethe (*Zeits f Phys*, 57, 815, 1929), who concluded that the electron affinity was greater than 0 75 volts

If we examine the first row of the periodic table, then it seems almost necessarily to follow from any reasonable extrapolation that the electron affinity will show the following behaviour For helium, it will be negative, indicating that He^{-} is not stable For lithium, it will be greater, perhaps positive, to decrease again with beryllium, increasing to carbon, decreasing to nitrogen, and increasing to fluorine, where the value is about 3 5 volts The second row shows a similar behaviour, the increases in both cases being linear

The first excited states of H^{-}, 2^1S and 2^3S, lie close below the normal state of H, and the states 2^1P and 2^3P both lie above, tending to show that no discrete

electron affinity spectrum for H^- is possible, as Bethe also concluded The data used in the extrapolation are taken from the International Critical Tables, vol 5, and from B Edlén and A Ericson (NATURE, **124**, 683, 1929)

If we consider the iso-electronic sequence Ca^{++}, K^+, A, Cl^-, using data from I S Bowen (*Phys Rev*, **31**, 457, 1919) and from K W Meissner (*Zeits f Phys*, **40**, 839, 1929), then assuming the second differences to be approximately constant, one obtains 3 volts for the electron affinity of chlorine, but the first excited state of Cl^- lies above the normal state of the chlorine atom, so one would likewise expect no discrete electron affinity spectrum here

A systematic investigation may possibly reveal elements which possess such a spectrum The present note merely purposes to direct attention to a method which may perhaps be used with profit in the search for whatever lines may exist Even the rough extrapolation used here would probably be helpful in estimating the position of 'polar' states of atoms at infinite separation, which information one needs in applying the Heitler and London method, as extended by Slater, to find the electronic energies of a diatomic molecule

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Cambridge, Feb 6

Energy Losses of Electrons in Mercury Vapour

A STUDY has recently been made by me of the effects of collisions with mercury atoms of electrons of energies of 8 volts, 18 4 volts, 34 6 volts, and 49 volts The collisions of the electrons and mercury atoms took place in a field free space from which those scattered at a definite angle passed into an analysing chamber

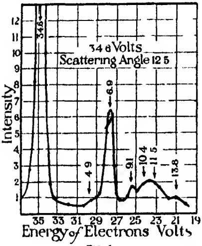

FIG 1

from which the mercury vapour had been removed Here a velocity analysis was made by an electrostatic method instead of by the usual magnetic field The paths of the electrons were bent by an electric field between two curved molybdenum plates While the experiment was in progress, a paper appeared by G P Harnwell (*Phys Rev*, vol **33**, p 559) in which the same method of analysis was used Apparently, however, it failed to give results with electrons of energies less than about 40 volts and the resolution was somewhat low Just recently, results of a similar experiment on energy losses in mercury have been published by Whitney (*Phys Rev*, vol **34**, p 923), in which a magnetic analysis was used giving about the same resolving power as the method used by me

The accompanying curves (Figs 1 and 2) show typical curves The main peak represents electrons which have suffered elastic collisions, the others electrons having lost various amounts of energy by inelastic collisions Most peaks could be measured with an error of not more than 0 2 volt

The inelastic peaks may be identified as follows

(1) An energy loss of about 4 9 volts This peak probably includes the 4 7 volt, 4 9 volt, and 5 4 volt energy levels, corresponding to the 1^3P_0, 1^3P_1, and

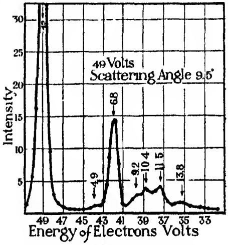

FIG 2

the 1^3P_2 levels The resolving power was not sufficient to separate the 4 7 volt and 4 9 volt levels, and the 5 4 volt peak is too close to the 6 7 volt peak

(2) An energy loss of 6 7 volts, the 1^1P_1 energy level This peak is several times as intense as any other at all voltages studied except at 8 volts, where the 4 9 volt peak appeared a little more prominent

(3) An energy loss of about 9 2 volts This probably corresponds to some of the many energy levels near ionisation

(4) An energy loss of 10 4 volts This corresponds to ionisation of the mercury atom

(5) An energy loss of 11 5 volts This may be the result of two successive collisions, one losing 4 7 volts or 4 9 volts, and the other 6 7 volts (See below)

(6) Another peak occurs at 13 5 to 14 volts It is not sharp enough to be located accurately It probably represents two collisions, each resulting in the loss of 6 7 volts

The first two peaks were also found to occur with about the same relative intensity by Whitney He worked at sixteen different voltages between 5 and 41 He found a peak at 9 7 volts which probably corresponds to mine at 9 2 He suggests it may be due to two successive collisions of 4 9 volts loss each He also gets a peak at 11 7 volts which without doubt corresponds to mine at 11 5 The exact position of this peak is a little uncertain in both experiments In his experiments it seemed to be mixed up and inseparable from the ionisation peak No doubt this is due to the fact that he worked at a pressure corresponding to a temperature of 94° C, while in my experiments the pressure was that corresponding to about 25° C

The intensity of the 6 7 volt peak is very striking The corresponding spectral line (λ1849) is very difficult to observe as it is so far in the ultra-violet These experiments when carried further should prove

valuable in estimating the relative probability of excitation to the various levels which are difficult to observe spectroscopically I think sufficient resolving power could be obtained to separate the 4 7 volts and 4 9 volt levels The method has the great advantage that the collisions take place in a completely field free space

The intensity of the 11 5 volt peak is surprising If it is the result of two successive collisions as explained above, it should be less intense than the 4 7 volt, 4 9 volt, and 5 4 volt peak No satisfactory explanation of its intensity has been found Foard, in an abstract (*Bull Am Phys Soc*, Dec 13, 1929), has described some similar experiments using a magnetic analysis He seems to have obtained slightly higher resolution He finds a peak at 7 7 volts, the 1^3S_1 energy level This peak does not occur either in my experiments or in those of Whitney Otherwise the same peaks were found

In the present experiment, the electron gun could be rotated to give an angular distribution of the scattered electrons and some results have been obtained They are not very accurate, and agree in general with those of Arnot (*Proc Roy Soc*, vol 125, p 660), so nothing further need be said about them

These experiments were made possible by the kindness of Prof A M Tyndall in placing the facilities of the Wills Physical Laboratory at the University of Bristol at my disposal The work was done while I held an 1851 Exhibition Senior Studentship

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Glancing Angle of Reflection from Calcite for Silver ($K\alpha_1$) X-Rays

We have measured the first order glancing angle at which the $K\alpha_1$ line of silver is reflected from the cleavage planes of calcite by a method independent of any used by those who have obtained the most reliable results so far The weighted mean value of fourteen independent observations reduced to 18° C is 5° 17′ 13 81″ ± 0 06″

This value was obtained from spectrograms taken on a new spectrometer specially designed to utilise the displacement method introduced by H S Uhler (*Phys Rev* [11], 11, 1 20, 1918) A full description of the method, instrument, and results will be given later

The value of the wave length corresponding to the above glancing angle is 0 558238 A ± 0 000002 A obtained by using 3 02904 A for the 'effective' grating space of calcite (Siegbahn, "Spectroscopy of X Rays", 1924 edition)

The thermal coefficient of expansion at 18° C for the grating space of calcite obtained from the most trustworthy sources, without approximations, is $0\ 0000102_2/°$ C This value differs by about 2 per cent from the generally quoted value originally given by W Stenström (Dissertation, Lund, 1919) as a sufficient approximation

It is interesting to note that our value of the glancing angle is 1 4″ smaller than that given by G Kellström (*Zeit f Phys*, 41, 516, 1927) for the first order of calcite, namely, 5° 17′ 15 2″ The probable error of the unweighted mean of Kellström's seven determinations for this order is $\pm 0\ 04_5''$ The unweighted mean of his four second order determinations is also larger than ours and has relatively four times this probable error With such a difference existing, one wonders if the grating spaces of the crystal specimens used were the same We employed an unusually selective piece of calcite which was cleaved from an excellent specimen of Iceland spar contained in the Marsh collection of Yale University

Our value is larger than those of K Lang (*Ann d Physik*, 75, 489, 1924), A Leide (Dissertation, Lund, 1925), and A P Weber (*Zeit f Wiss Photo*, 23, 149, 1925), although coming within 0 11″ of Lang's and 0 36″ of Leide's results when their probable errors are added to their respective mean values

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The Nuclear Moment of Lithium

The fact that the hyperfine structures of spectral lines are so much narrower than the multiplets in the same spectrum is due principally to the fact that the latter are produced by the magnetic moment of the electrons, while the former originate from the magnetic moment of the nucleus, which is usually attributed to nuclear protons, and is, therefore, about 1840 times smaller

The hyperfine structure of the Li^+ spectrum, discovered by Schuler (*Zeit f Phys*, 42, 487, 1927) is of the same order of magnitude, however, as the multiplet separations themselves From this fact Heisenberg (*Zeit f Phys*, 39, 516, 1926) drew the conclusion that the magnetic moment of the lithium nucleus was of the same order of magnitude as that of an electron, and therefore caused by electrons in the nucleus and not by protons The experiments of Taylor (*Zeit f Phys*, 52, 846, 1929) on the Stern Gerlach effect with lithium atoms failed, however to indicate the expected large magnetic moment for the nucleus

In the following we will show that the nuclear magnetic moment is not very large, and that the wide hyperfine structure is caused by the presence of a single 1*s* electron in the configurations considered

In a recent letter to Nature (125, 16, 1930), Fermi has given an expression for the interaction between the nuclear moment and the external electrons derived from quantum mechanics [1] For an *s* state in an hydrogenic atom the doublet separation (*s* states have $j = 1/2$ and thus split into two levels) will be

$$\Delta\nu = \frac{8}{3} R\alpha^2 \frac{Z^3}{n^3} \frac{g(i)}{1840} (i + \tfrac{1}{2})$$

In this expression we denote by $g(i)$ the ratio between the magnetic and mechanical moments of the nucleus, its Landé g value, but in units 1840 times smaller than used for electrons, in order to obtain the magnetic moment of a spinning proton as unity Since the mechanical moment of a spinning proton is 1/2 quantum unit, its $g(i)$ is thus 2 The mechanical moment of the nucleus is denoted by i

Applied to doubly ionised lithium the lowest *s* state would have a doublet separation of

$$\Delta\nu = 0\ 228\ g(i) \ (i + \tfrac{1}{2}) \text{ cm}^{-1}$$

For the 1*s* 2*s* and 1*s* 2*p* configurations of Li^+ we may assume that the hyperfine structure is mainly due to the presence of the 1*s* electron The added electron will have some screening effect on the 1*s* electron, but as it is an outer electron this effect will be very small Furthermore, the screening effect of the 1*s* electron upon the 2*s* or 2*p* electron will be large, and as these

[1] The same expressions were known to us before from unpublished material of H Casimir presented at a meeting in Copenhagen last April For a general state in an hydrogenic atom Casimir obtains for the interaction energy

$$\Delta E = Rhc\alpha^2 Z^3/n^3(l + \tfrac{1}{2})j(j+1) \ g(i)/1840 \ ij \cos(i, j)$$

electrons have $n=2$ their interaction with the nucleus will be far smaller than that of the $1s$ electron, and will be neglected here

To obtain finally the hyperfine structure for the $1s\,2s\,{}^3S$ and $1s\,2p\,{}^3P$ states of Li^+, use is made of the expressions derived by Goudsmit and Bacher (*Phys Rev*, **34**, 12, 1929) Assuming for simplicity $i=1/2$, which does not affect the order of magnitude of our results, we expect to a first approximation

		Calc	Obs
${}^3S_1$	$\Delta\nu =$	$0\ 17\ g(i)$	$0\ 6\ cm^{-1}$
${}^3P_2$	$=$	$0\ 14\ g(i)$	$0\ 3$
${}^3P_1$	$=$	$0\ 085\ g(i)$	$0\ 3$

The result is that the expected separations are not of an order of magnitude 1840 times smaller than the multiplet separation of ${}^3P$, which is approximately $5\ cm^{-1}$

Recently Schuler and Brück (*Zeit f Phys*, **58**, 735, 1929) have given a tentative analysis of the Li^+ hyperfine structure leading to $i=1/2$, and giving the separations mentioned as observed in the above table With respect to the uncertainty in the screening effect and interpretation, their results indicate a $g(i)$-value of about 3 to 6 (It was hoped that this value would be approximately 2) The application of these formulæ to hyperfine structure in other atoms, which can be done to a first approximation by replacing $(Z/n)^3$ by Zz^2/n_0^3, also seems to lead to rather large values for $g(i)$

If the tentative interpretation of this hyperfine structure given by Schuler and Brück is correct, the hyperfine splitting is *inverted* Another example where this is the case is the cadmium isotope with $i=1/2$ (Schuler and Brück, *Zeit f Phys*, **58**, 737, 1929) This means that the magnetic moment of the nucleus is related to its mechanical moment as if it were due to *negatively* charged particles However, it is possible, though improbable, to have a complicated configuration of positive particles for which the resultant magnetic moment is oppositely directed to the mechanical moment Something similar occurs for the extra nuclear electrons in certain complicated configurations which show a negative Landé g value (for example, ${}^6F_{1/2}$, with $g=-2/3$)

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Jan 30

Moment of Inertia of Hydrogen from Band Spectra

THE commonly accepted value of the moment of inertia of the hydrogen molecule, in the normal state, is due to Hori (*Zeit f Phys*, **44**, 834, 1927) In deriving this value, Hori expressed the rotational energy as $E_m = B_v m^2 + D_v m^4$, and calculated empirical values of D_v directly from the data The term $D_v m^4$ is due to the swelling of the molecule with rotation, and it is now well established that the theoretical values of D_v hold accurately in the case of electronic levels for which there is no resultant electron momentum to complicate matters This is the situation in the normal level of hydrogen (${}^1\Sigma$) Hori's values of D_v are several times as small as those given by theory and, what is more important, are positive, whereas a *swelling* of the molecule with rotation requires that they be negative Hori made note of this discrepancy in sign, but was unable to explain it We find, however, in agreement with Schaafsma and Dieke (*Zeit f Phys*, **55**, 164, 1929) that Hori's data, although relatively inaccurate and meagre, *do* indicate negative values of D_v, and we are unable to locate the origin of his published values It should be pointed out, in addition, that Hori's data give probable errors for B_v (his A_v) and D_v (his β) ten to one hundred times as large as his published errors for these quantities

There are now available much more extensive and accurate data for the normal state of hydrogen Schaafsma and Dieke (*loc cit*) have published rotational energy data, based on H_2 plates obtained by Dieke and Hopfield (*Phys Rev*, **30**, 400, 1927) on the 50 cm vacuum spectrograph at the University of California One of us (see H H Hyman and R T Birge, NATURE, **123**, 277, 1929) has recently obtained similar data from spectrograms taken with Prof Hopfield's new 10 ft vacuum spectrograph Using all available data from these sources, and employing the various known theoretical relations, we have calculated values of B as a function of v, and find

$$B_v = 60\ 587 - 2\ 7938(v+1/2) + 1\ 0500\times 10^{-2}(v+1/2)^2 - 24\ 058\times 10^{-4}(v+1/2)^3$$

In this equation, the actual vibrational energy levels are given by $v=0, 1, 2$, etc, and the available data run from $v=1$ to 12 inclusive The equation is entirely satisfactory from $v=1$ to 9 The higher values of v lie close to dissociation and the observed values of B_v are smaller than those given by the equation

The most important constant is of course B_0, corresponding to the lowest actual vibrational level ($v=0$) The absorption bands of the $B\ A$ system, observed and measured by Dieke and Hopfield (*loc cit*) lead directly to a value of B_0, but the probable error is quite large On the other hand, only one emission band (observed by Witmer, *Phys Rev*, **28**, 1223, 1926) is available for this purpose, and the data in this case are very fragmentary It is therefore necessary to evaluate B_0 by extrapolation, using the equation just given, with $v=0$ The extrapolation in this case is quite trustworthy *provided* the B_v curve is really smooth The result is $B_0 = 59\ 192\ cm^{-1}$ Using the new conversion factor $(27\ 66\pm 0\ 04)\times 10^{-40}$, given by Birge (*Phys Rev*, Supplement **1**, 1, 1929), one then obtains $I_0 = 0\ 4673\times 10^{-40}\ gm\ cm^2$, and $r_0 = 0\ 7500\times 10^{-8}\ cm$ Hori found $B_0 = 57\ 77$, giving $I_0 = 0\ 479\times 10^{-40}$ This differs from our value by 2 2 per cent

In this connexion we should like to emphasise that Hori's published $I = 0\ 467\times 10^{-40}$ refers to the true state of zero vibration ($v=-1/2$) and would now be denoted I_e Nearly everyone has quoted and used Hori's I_e value as though it were I_0 Our own value of B_e is given by the constant term in our equation (60 587), and this leads to $I_e = 0\ 4565\times 10^{-40}$, $r_e = 0\ 7412\times 10^{-8}$ It is interesting to note that Wang (*Phys Rev*, **31**, 579, 1928) obtained $I_e = 0\ 459\times 10^{-40}$, from a theoretical wave mechanics calculation We believe that the probable error in the values of B_1 to B_9, as given by the above equation, is 0 1 per cent, or less So far as the uncertainty of the extrapolation is concerned, the probable error in B_0 and B_e is not more than 0 2 per cent It is, however, shown in the following letter by Birge and Jeppensen that B_2 is definitely perturbed, so that our value is not correct Whether B_e is correct cannot be tested, since this constant refers to a molecular state which does not exist.

This work has been carried out with the advice and assistance of Prof R T Birge, to whom we wish to express our sincere thanks

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C RULON JEPPESEN

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Jan 10

Moment of Inertia of Hydrogen from Raman Effect

F Rasetti (*Phys Rev*, **34**, 367, 1929) has recently obtained accurate data on the Raman effect for gaseous hydrogen From his data it is possible to calculate extremely precise values of B_0 and B_1 This is very fortunate, for it is now possible, from band spectra, to obtain an accurate value of B_0 only by extrapolation, as has been shown in the preceding letter by Hyman and Jeppesen Because of the importance of this constant, it has seemed advisable to make a searching analysis of Rasetti's data, using all known theoretical relations

We have expressed the rotational energy as $E_m = B_v m^2 + D_v m^4 + F_v m^6$, where m is a half integer for the actual rotational levels We have calculated values of D_v from the theoretical relations derived by Kemble The only value of F which is known theoretically is F_e, but this can be used safely for F_v, when v is small We have also paid scrupulous regard to the difference between derivatives and finite central differences For most molecules the distinction can be ignored, but this is not at all the case for hydrogen Rasetti, in his calculations, omitted the $F_v m^6$ term, although his data clearly require it He also used D_v as constant, $= D_e$ Besides the rotational constants for $v = 0$ and 1, his data also evaluate $\omega_{1/2}$, the separation of these two vibrational levels, for zero rotation ($m = 0$) Using all of his data, we get $\omega_{1/2} = 4161\ 70$ cm $^{-1}$ Rasetti's value of 4161 8 is based on a single line

This value of $\omega_{1/2}$ is most interesting, for it lies definitely *off* the smooth ω_v v curve Hyman's new data have not yet been analysed for ω_v values, but the older data lead to $\omega_{1/2} = 4146$ cm $^{-1}$, with a probable error not greater than 2 cm $^{-1}$, so far as the extrapolation is concerned The discrepancy of 16 cm $^{-1}$, or 0 38 per cent, is therefore real Such a *vibrational* perturbation seems to be quite unprecedented, and obviously cannot be explained as due to the crossing of two sets of rotational levels Such a crossing, in any case, affects only certain *lines* of a band, and not the entire band Even the older data give 4159 cm $^{-1}$ for $\omega_{1/2}$, as one of us noticed several years ago, but Rasetti's work is the first to establish definitely the existence of this irregularity One disturbing consequence of the irregularity is that one cannot be certain of the value of ω_e, the frequency of vibration for infinitesimal amplitude In calculating D_v values, we have used $\omega_e = 4371$, as derived from a *smooth* ω_v curve, ignoring $\omega_{1/2}$ The resulting uncertainty in D_v is negligible, in any case

Our final calculated values of B_0 and B_1, from Rasetti's data, are 59 354 cm $^{-1}$ and 56 4035 cm $^{-1}$, respectively, as compared with Rasetti's published 59 40 ± 0 03, and 56 47 So far as the consistency of the data is concerned, our own calculated values have a probable error of less than 0 01 cm $^{-1}$, but the real probable error is doubtless several times as large Using all our derived constants, Rasetti's sixteen measured lines are represented with an average residual of 0 24 cm $^{-1}$ His own average residual is 0 36 cm $^{-1}$ The agreement with theory is remarkably close in every detail, and this is especially gratifying, since the hydrogen molecule provides the most severe test of any theory of band spectra

The equation for B_v, derived by Hyman and Jeppesen from band spectra data *only*, gives $B_1 = 56\ 4115$ cm $^{-1}$ This agrees with our value from Raman effect to *one part in seven thousand* It is the most accurate check between Raman effect and band spectra data that has yet been found, and is again a most satisfactory confirmation of theory On the other hand, the Raman effect value of B_0 is 0 27 per cent greater than the *extrapolated* band spectrum value The agreement of the B_1 values shows that the B_v equation given by Hyman and Jeppesen is entirely correct at $v = 1$, and hence its extrapolation to $v = 0$ is certainly correct to 0 1 per cent or less We therefore have a *perturbation* in the moment of inertia of the *lowest* vibrational state of hydrogen Since the separation of vibrational levels is assumed to measure an average value of the classical frequency of vibration in the two levels concerned, the conclusion seems almost inevitable that in the lowest vibrational level of hydrogen the frequency of vibration is *greater* and the moment of inertia *less* than the values to be expected from the constants for the other vibrational levels

The essential correctness of the value of B_0, as derived from Raman effect, cannot be questioned Hence the true I_0 for hydrogen is 0 46602 × 10^{-40} gm cm ^{2}, $r_0 = 0\ 74891 \times 10^{-8}$ cm These constants are given to five significant figures, like B_0, but it should be remembered that the conversion factor has itself a probable error of one part in seven hundred As noted by Hyman and Jeppesen, the value of B_e now becomes indefinite, due to the irregularity in B_0 but in the absence of contrary evidence, it seems best to use, for both B_e and ω_e, when calculating derived constants, the smooth extrapolated values already given

Raymond T Birge
C Rufon Jeppesen

University of California,
Berkeley, California, Jan 10

Raman Spectra of Crystalline Powders

In a recent communication (Nature, Nov 2, 1929) Prof R Bar of Zurich has shown that it is possible in many cases to photograph the Raman effect with solids in a state of powder The difficulty encountered by him, and also by Dr A C Menzies (see Nature, Oct 5, 1929), of the continuous background in the spectrum which overpowers all but the strongest Raman lines, is, however, serious, as it interferes with the general utility of the method During the past two months I have been engaged in an attempt to overcome this difficulty, and have found that it may practically be avoided by running the mercury arc at a lower temperature, and, where necessary, also by interposing a suitable light filter between the arc and the illuminated substance A concentrated solution of didymium chloride proved especially useful for this purpose Thus, for example, all the four lines obtained by Schaefer with a large single crystal of sodium nitrate may, with equal success, be photographed in about half an hour by using an irregular aggregate of small crystals placed within a small triangular shaped cell with mirrored walls

Prof Bär has found that in the case of naphthalene the Raman lines appear in the same position in the crystal powder as in the liquid My results with benzophenone crystals and liquid show that a marked change in the position of some of the Raman lines occurs on fusion of this substance, this is best seen with the line usually attributed to the ketonic group, which gives a shift of 1657 wave numbers in the liquid and 1650 in the solid, and is also noticeably sharper in the latter It is clear that a promising field of research offers itself in the comparative study of the Raman spectra in the liquid and solid states

About eighteen inorganic nitrates have also been examined by this method, some anhydrous and the others as hydrates It was noticed by Schaefer and by Bär that the inactive frequency of the NO_3 group in $NaNO_3$ crystals differed appreciably from the value in its aqueous solution In the present investigation, the largest shifts corresponding to the inactive frequency were given by lithium, sodium, and mag-

nesium nitrates (1071, 1070, and 1060 wave numbers respectively) The values obtained with calcium, barium, and lead nitrates were not much different from the value for nitric acid (1045), while mercuric and bismuth nitrates showed smaller frequency shifts (1037 and 1040 wave numbers respectively) In some cases, for example, lithium, aluminium, and mercuric nitrates, the line was accompanied by a fainter component

It is interesting to note that in nitrate crystals belonging to the cubic system the frequency shift is almost the same as for nitric acid in spite of the varying size of the metal atom (for example, calcium, barium, and lead nitrates) Of the other two frequencies, the 7 μ line appeared only in the case of lithium and sodium nitrates The 13 μ line, however, was more persistent and appeared in the case of lithium, sodium, ammonium, potassium, barium, and lead nitrates The Raman line corresponding to a remote infra red frequency appeared prominently in lithium and mercurous nitrates (42 9 μ and 57 2 μ respectively), and was also noticeable with sodium, calcium, barium, zinc, silver, and mercuric nitrates

P Krishnamurti

Raman Effect in Liquefied Gases

In a recent investigation by Daure (*Trans Faraday Soc*, **25**, 825, 1929) on the Raman effect in liquefied gases, it was found that the spectrum of liquid ammonia includes three strong lines the displacements of which are 321, 330, and 338 mm $^{-1}$ Two of these lines (321 and 330 mm $^{-1}$) have already been observed by Dickinson, Dillon, and Rasetti (*Phys Rev*, **34**, 582, 1929), who found the line 330 to be very strong and the other slightly weaker Now the Raman spectrum of ammonia vapour as reported by Wood (*Phil Mag*, **7**, 744, 1929) shows only the line 330 mm $^{-1}$, hence Daure ascribes the two new lines to some complex such as $H_3N = NH_3$ It seems to me that this observation is significant and worthy of more consideration

To begin with, it will be noted that the two new lines may be accounted for, within the limit of accuracy of Daure's measurements, by the expression 330 ± 8 mm $^{-1}$ This is precisely the sort of expression which gives the displacements of the Raman effect in general, and it suggests that the outer lines represent a scattering of the light which gives the central line by complex or associated molecules In other words, these lines may arise from a secondary Raman effect in the liquid Unfortunately, Daure reports only the 'negative' lines (displaced towards the red), so that no check can be made on the structure of these lines on the 'positive' side

The chance that this relation is mere coincidence is reduced by the data of Daure for liquid ethane, which exhibits in this region a similar triplet structure which may be represented by the expression 291 ± 4 mm So far as I am aware, the Raman effect in ethane vapour has not been reported, but if the viewpoint outlined above is correct, it should contain only the line displaced 291 mm $^{-1}$

One experiment which suggests itself as a confirmation of this interpretation is a determination of the polarisation of these lines If the two liquid lines have the same polarisation, it would be strong evidence that they are related in the manner suggested

If such an effect could be established, it would provide a valuable tool for investigating molecular complexes and associated liquids A few inferences on this basis will serve to indicate its power The frequency displacements of the liquid lines, ± 8 mm $^{-1}$ and ± 4 mm $^{-1}$ would indicate that the vibrations of the components of the complex are much smaller than those of the atoms in the molecules, which is to be expected Moreover, the fact that both positive and negative lines are quite intense would point to the existence of a considerable portion of the complexes in an excited state, probably closely akin to Henri's conception of 'predissociation' It is hoped that more data will shortly be available so that some of these questions may be settled

J B Austin

Research Laboratory,
United States Steel Corporation,
Kearny, N J

Raman Lines of Mercury in Arc improbable

A communication by Venkatesachar and Sibaiya appeared in Nature for Nov 30, 1929, in which the opinion was expressed that some of the faint nebulous lines of the mercury arc were in reality Raman lines of mercury excited by the more powerful radiations

This did not seem to me very probable, and I have investigated the matter with a new 220 volt quartz arc provided with a window of polished optical quartz which permits end on observation of the long narrow cylinder to which the discharge contracts when the arc operates on full load The region surrounding this highly luminous cylinder is comparatively dark, and would seem to be the most promising field in which to search for Raman lines

An end on image of the discharge was focused on the slit of a large quartz spectrograph by means of a quartz fluorite objective The image, a small circular disc of intense brilliancy, was blocked off with a strip of black paper, which was removed for half a second, at the end of the exposure The spectrum of the irradiated vapour above and below that of the disc was comparable in density with that of the discharge There was no relative enhancement of the lines indicated by Venkatesachar, if anything, they were a little stronger in the spectrum of the discharge than in the spectrum of the irradiated vapour

R W Wood

Johns Hopkins University,
Baltimore, Feb 15

Raman Effect for Solutions of Sulphur Dioxide

Studies of the Raman effect for hydrogen chloride and for ammonia as gases, as liquids, and in aqueous solution have been made by various investigators With ammonia, the same modified line appears in all three cases Hydrogen chloride reveals the same scattered line in the liquid and gaseous states, but, as is to be expected, not in aqueous solution

We have investigated the scattering of sulphur dioxide in various solvents, such as water, benzene, and carbon tetrachloride, and intend to work with the pure liquid and the gas In addition to the modified lines arising from the solvent, there occur, in each instance, lines characteristic of the sulphur dioxide molecule The most prominent of these lines appear in all of the solvents at λ4588 and λ4238, excited, respectively, by λ4358 and λ4047 of the mercury arc The shift indicates an infra red wave length of 8 8 μ This is very close to the mean value of about 8 7 μ for the band from 8 4 μ to 9 0 μ, which is one of the most intense two of the six infra red absorption bands found by Coblentz for this gas

The replacement of the broad infra red band by a Raman line may be due to the faintness of the *P* and *R* branches in the spectrum adjacent to this line, and the appearance of a *Q* branch in the Raman spectrum, as was found by Wood for hydrogen chloride

William D Harkins
David M Gans
Harold E Bowers

University of Chicago, Jan 6

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Obituary

DR J G DE MAN

THE Dutch zoologist Dr Johannes Govertus de Man, who died at Middelburg on Jan 19 last in his eightieth year, was well known as an authority on two very diverse groups of animals, the free-living Nematode worms and the Decapod Crustacea

De Man was born in 1850 at Middelburg, where his father, Dr J C de Man, was a physician well known throughout the Netherlands He studied mathematics and natural science at the University of Leyden, where he received the degree of doctor in 1873 for a thesis, "Comparative Studies on the Myology and Neurology of Amphibia and Birds" He was appointed first assistant in the State museum of natural history in Leyden in 1872, and three years later was promoted to be conservator He had studied under Leuckart at Leipzig in 1872, and in 1876 he spent some months at the recently established zoological station at Naples, where, however, his stay was cut short by a severe attack of typhoid In 1881–82 he worked in Selenka's laboratory at Erlangen, studying the sipunculid worms collected by Semper on his expedition to the Philippine Islands

In 1883 de Man had to resign his post at the museum at Leyden owing to prolonged ill health and he retired to pursue his studies, first at his parents' home at Middelburg and later in a house which he built overlooking the Scheldt at Ierseke Here he lived the quiet life of the student, working out collections from museums and expeditions all over the world, appealed to by the neighbouring fishermen when anything out of the common came to their nets, and explaining to the children the nature of the treasures gathered on their seaside rambles Although he took no part in public life, his purse was ever open to appeals for charitable or useful purposes None could have been more courteous and helpful to those who sought information by correspondence, and none more careful to give acknowledgment for any assistance he received

The free living nematodes are a group little studied in comparison with those species that, by reason of their parasitic habits, come into more direct relation with human affairs, and few zoologists have any suspicion of their abundance or their variety In their study de Man was, after Bastian, one of the pioneers, and his work on them will not soon be surpassed for thoroughness and precision On the Decapod Crustacea, his numerous memoirs and papers, full of the most careful and detailed description and beautifully illustrated by his own pencil, remain as a mine of information for all students of the group An obituary notice in the *Nieuwe Rotterdamsche Courant* of Jan. 29 concludes with the words, "He leaves a blank, not only in the learned world, but also among the simple fisher-folk of Ierseke", a fitting epitaph for the kindly old scholar

W T C

LIEUT C B EIELSON

THE loss of Lieut Eielson removes one of the most experienced Arctic pilots and a pioneer in polar aviation On Nov 9 last year, he set out from Teller in Alaska on a second aeroplane journey to the ice-bound vessel *Nanuk*, off Cape North, Siberia On his failure to arrive, search parties were sent out, and during the month of February discovered the bodies of Lieut Eielson and his companion, Mr E Borland, near the wrecked machine about 90 miles south-east of Cape North

Carl Ben Eielson was an American of Norwegian descent In 1923 he was the first pilot to use an aeroplane in Alaska, and his success led to his being employed to carry mails during winter In 1926 he joined Mr (now Sir) Hubert Wilkins in his trial tests over the Arctic Ocean, which were continued in 1927 in preparation for a transpolar flight In that year they flew more than five hundred miles to the north west of Cape Barrow On the return, a forced descent on the pack ice was followed, after a second start, by another descent, which entailed leaving the machine and marching 75 miles over the ice to land This was done in two weeks, without any considerable difficulty

In 1928, Eielson piloted Wilkins's machine from Point Barrow via northern Greenland to Spitsbergen This was a flight of twenty hours and remarkable for its daring and skilful navigation In the same year Eielson went to the Antarctic with Wilkins and was his pilot in his 1200 mile flight in December, which resulted in the discovery that Graham Land is a series of islands

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We regret to announce the following deaths

The Rt Hon The Earl of Balfour, F R S, Chancellor of the University of Cambridge and of Edinburgh, on Mar 19 aged eighty one years

Mr T A Barns, a well known Central African traveller and naturalist, on Mar 4, aged forty eight years

Mr R Moir Clark, until last year lecturer in agricultural botany at the University of Aberdeen and secretary for many years of the Aberdeen Natural History Society, aged sixty three years

Mr Edward Clodd, distinguished by his work and publications on folk lore and anthropology, on Mar 16, aged eighty nine years

Dr A T Hadley, emeritus president of Yale University and a distinguished economist, aged seventy-three years

Prof Maurice R J Hayes, professor of materia medica and therapeutics, University College, Dublin, and first Director General of the Irish Free State Army Medical Service, who was an authority on radiology, on Mar 2, aged fifty one years

Dr J B Hurry, formerly medical officer of Reading and author of a series of books on "Vicious Circles" which appeared in many languages, on Feb 15, aged seventy two years

Dr K J P Orton, F R S, professor of chemistry, University College of North Wales, on Mar 16, aged fifty-seven years

News and Views.

FOR the centenary meeting of the British Association for the Advancement of Science, which will be held in London next year on Sept 23–30, the Council has unanimously resolved to nominate Gen the Right Hon J C Smuts as president of the Association, and he has accepted the nomination It was felt that, for the London meeting, the president should be a leading statesman or other representative of the British Empire with scientific interests instead of being distinguished for work in a particular branch of science Usually, the presidents elected represent alternately the physical and the biological sciences, and little consideration is given to the appropriateness or otherwise of their special subjects to the place of meeting If the Prince of Wales had not been president of the Oxford meeting in 1926, he would obviously have been of unique significance as president of the centenary meeting in London His interests in South Africa suggest, however, that he would welcome the nomination of Gen Smuts, who is so very highly respected in that country

GEN SMUTS has wide interests in many fields of practical life and intellectual activity, and has won distinction in all of them He is a statesman with high principles and broad outlook, a naturalist who has done original field work in botany, and a philosopher who has correlated observations and conclusions into a coherent scheme His work on "Holism and Evolution", published in 1926, was a wide and original survey of evolutionary philosophy of a universe vitalised by a great driving force The great characteristic of the world of Nature is held to be the tendency to the development of 'wholes' The work revealed Gen Smuts as a scientific student and thinker of great knowledge and remarkable power of expression His presentation of Darwin's principles and discussion of the work and conclusions of Mendel and Weismann and their disciples showed both just appreciation and sound judgment, and his general thesis was a valuable contribution towards the merging together of science and philosophy Gen Smuts was president of the South African Association for the Advancement of Science in 1925, and in his presidential address on "Science in South Africa", the main part of which was published in NATURE of Aug 15, 1925, he presented a comprehensive survey of scientific problems of the southern hemisphere from the point of view of South Africa as the appropriate centre from which to correlate them Whatever may be the subject of his address at the London meeting next year, we are sure that it will be dealt with in a masterly way and will command the attention of all interested in progressive life and thought

PROF BOHUSLAV BRAUNER, the eminent Czechoslovak man of science, distinguished for his investigations in the chemistry of the rare earth elements, has just attained the jubilee of his 'promotion' as doctor of philosophy at the Charles University of Prague This event was celebrated according to the traditions of the University by a solemn renewal of his diploma on Feb 28 Prof Brauner has also recently been made an honorary member of the Polish Chemical Society, thus adding to the long list of foreign distinctions which have been conferred upon him in recognition of his researches in inorganic and analytical chemistry Among his more important discoveries mention may be made of his independent isolation of fluorine, carried out at Manchester in the early 'eighties, the recognition of the complexity of didymium and its fractionation into praseodymium, neodymium, and samarium He was among the first to realise the full significance of Mendeléeff's periodic classification of the elements and in support of it he undertook the redetermination of the atomic weights of many rare earth and other metals He had deduced, so early as 1877, that beryllium must be bivalent and therefore has the atomic weight 9, thus bringing it into line with Mendeléeff's scheme Prof Brauner's interest in the classification of the elements brought him into close contact with the Russian savant, and their intimate friendship only terminated on Mendeléeff's death Prof Brauner shares his countrymen's talent for languages, and writes with equal facility in six or seven European languages Many of his original researches have appeared in English journals, including NATURE Mention must also be made of his influence in Central Europe, for he has established, at the Chemical Institute of the Charles University of Prague, a school of research which maintains the high traditions associated with his work

IN the early part of the year 1830, Charles Lyell, F R S, foreign secretary of the Geological Society, published the first volume of the "Principles of Geology", and its centenary of issue and contemporaneous influence on scientific thought is worthy of recall Four years afterwards, the Royal Society awarded Lyell (he was not knighted until 1848) a Royal medal, with apt expression "For his work entitled 'Principles of Geology', in recognition of its comprehensive and philosophical spirit and dignity, and the important service rendered to science by specially directing the attention of geologists to effects produced by existing causes" As an exponent of the philosophy underlying geological study, and a historian of agencies in Nature he opened up new vistas for the men of his day During a period of forty years Lyell continued to enlarge and improve his work, bringing out no fewer than eleven editions "Which of us", asked Huxley, in his anniversary address to the Geological Society in 1869, "has not thumbed every page of the 'Principles of Geology'?" Lyell was born at Kinnordy, his father's seat near Kirriemuir, Forfarshire, on Nov 14, 1797 Educated at a private school at Midhurst, he graduated at Exeter College, Oxford, studying later for the Bar, though he never practised, his tastes leading him to geological pursuits Lyell was elected into the Royal Society in 1826, at the same time as Roderick Murchison He was created a baronet in 1864 He died at his home in Harley Street, London, on Feb 22, 1875, being then

in his seventy eighth year, and was buried in Westminster Abbey

ON Mar 29 occurs the centenary of the death of Major James Rennell, one of the most eminent of British geographers The son of an army officer, Rennell was born in 1742 at Chudleigh, Devonshire, and at the age of fourteen entered the Navy After some service in home waters, he was sent to the East Indian station, where he saw active service and gained considerable experience in the practice of marine surveying At the close of the Seven Years War he obtained his discharge from the Navy, entered the service of the East India Company, and in 1764 was appointed Surveyor General of Bengal and given a commission in the Bengal Engineers His labours were of great importance to Indian geography for, as the result of thirteen years' hard work, he was able to publish his Bengal Atlas, and in 1783 he published the first approximately correct map of India By that time, as a result of the climate and wounds, he had been retired on a pension of £600 a year, and for more than fifty years afterwards he lived in London, devoting his whole time to geography His house became the meeting ground of travellers and explorers, he was consulted by various bodies, and reports were sent to him from all over the world His writings on Herodotus, Troy, Asia, and Africa attracted much attention, and his work on currents and winds is recalled to every navigator by the Rennell Current which flows northward from the coast of France towards the Scilly Islands He was made a fellow of the Royal Society in 1781 and awarded the Copley Medal in 1791, he was also an associate of the Paris Academy of Sciences At his death he was buried in the nave of Westminster Abbey, where his bust and a memorial tablet are to be seen

AT the twenty second annual meeting of the Institute of Metals, held on Mar 12–13, Dr Richard Seligman was inducted as president for the current year Dr Seligman was born in London in 1878, and educated at Harrow and (1895) at the Central Technical College (City and Guilds Institute), under Prof H E Armstrong, he was awarded the College associateship in 1898 He then studied chemistry at the University of Heidelberg, and transferred to Zurich in 1900, being engaged in research work with Prof Eugen Bamberger Returning to Heidelberg he gained his doctorate in 1902 After a period in the Niagara Research Laboratories, N Y, he became chief chemist to the United States Zinc Company of Pueblo, Colorado In 1905 he commenced specialisation in his main work with his appointment as chief chemist to the British Aluminium Company, which appointment he relinquished in 1909 to form the Aluminium Plant and Vessel Co, Ltd, Wandsworth, London The activities of this concern have been devoted to the development of aluminium in the service of industry, originally in the welding processes which enabled large scale plant to be devised, and latterly in the associated technological work involved in its use in the foodstuffs, chemical, and other industries

HIS MAJESTY THE KING has approved the award of the Royal Medals for 1930 of the Royal Geographical Society as follows Founder's Medal to Mr F Kingdon Ward, for his geographical explorations and work on botanical distribution in south west China and south east Tibet, Patron's Medal to Mr C E Borchgrevink, for his pioneer Antarctic expedition of 1898–1900, which was the first to winter in the Antarctic, to travel on the Ross Barrier, and to obtain proof of its recession The Council of the Society has made the following awards Victoria Medal to M Emmanuel de Margerie, for his distinguished contributions to the science of land forms, Murchison Grant to Colonel H Wood, for his surveys with the Tibet Mission and the De Filippi Expedition to Central Asia, Back Grant to Mrs Gordon Gallien, for her expedition to the Kalambo Falls, Cuthbert Peek Grant to Mr Owen Lattimore for his travels in Mongolia and Chinese Turkistan, Gill Memorial to Lieut Col Reginald Schomberg, for his explorations in the Tarim basin and the Tien Shan

PROF R A SAMPSON, Astronomer Royal for Scotland, described the purpose and design of the new equipment at the Royal Observatory, Edinburgh, in a paper read before the Optical Society on Mar 13 The reasons which determined the form of the new telescope—a Cassegrain reflector of 36 inches aperture and 54 feet focal length, serving a spectrograph of one, two, or three prisms—were discussed, and the problems to which the instrument is to be applied were indicated Speaking generally, the main problem is the intensity of stellar light for different parts of the spectrum It was pointed out that even an empiric treatment of this question led Adams to a method that has doubled our knowledge of stellar distances A theoretical treatment, comprising a discussion of the behaviour of the photographic plate, led to fixing the temperature sequence A slit spectrograph is required in order to deal with the lines The state of the lines, combined with that of the continuous spectrum, conveys all the information that reaches us of the star's constitution and atmosphere Subsidiary but highly interesting questions are those of selective absorption of light by the atmosphere of the earth Behind these is the theoretical and laboratory investigation of the relation between intensity of light and the density of silver deposit on the photographic plate The whole presents an attractive field Mr C Young, of Messrs Sir Howard Grubb and Parsons, Ltd, described the reflector, and Mr J H Dowell, of Messrs Adam Hilger, Ltd, the spectrographic equipment

NEARLY a year ago a sub committee of the Committee of Civil Research was appointed, under the chairmanship of Mr E R Peacock, "to examine and report on the economic aspects of proposals for the construction of a Channel tunnel or other new form of cross Channel communication" A report has now been issued (Cmd 3513 London H M Stationery Office, 1930 3s net), signed by all the members of the committee, subject to a 'minute of dissent' by Lord Ebbisham It appears that only two schemes

were put before the committee, one of which is dismissed as impracticable and prohibitive in cost, while the other, due to the Channel Tunnel Co, is reviewed in detail The proposal is for two independent traffic tunnels each of 18 ft 6 in diameter and a pilot tunnel of 10 ft diameter for drainage and ventilation The tunnel approaches would be about 12 miles long and 24 miles would be under the Straits of Dover The cost of the pilot tunnel is estimated at £5,000,000 and the remainder of the workings at £25,000,000, the pilot tunnel would take about 2½ years to drive, and the whole scheme might be completed in 6½ years It will be remembered that the geological evidence on the possibility of constructing a Channel tunnel was discussed by Mr John Pringle in an article in Nature of April 20, 1929, p 608, wherein it was shown that, geologically, such a tunnel is practicable The committee of inquiry concurs with this view, but suggests that the final decision should await the completion of the pilot tunnel It is concluded that a Channel tunnel should be built and maintained by private enterprise and that it would be of economic advantage to Great Britain Lord Ebbisham, in his 'minute of dissent', opposes the scheme on economic grounds

In a lecture by Sir Harry Haward, the vice chairman of the Electricity Commission, to the Surveyors' Institution on Mar 10, a clear and interesting account was given of recent developments in the electricity supply of Great Britain Since 1920, the amount of plant installed in generating stations has been trebled and the cost of a unit to the consumer has been nearly halved To the non technical reader, the working of the scheme may be described as follows The merging of the general sources of a district provides a regional pool of electrical energy This pool is fed from selected stations operating under a definite control The more efficient stations work three shifts and take what is termed the constant load The less efficient stations work on a two or even a one shift basis Contributions to the pool are also derived from energy produced by waste heat from industrial works and other sources The central board purchases the whole of the output of selected stations and the owners buy back the amount required for their own use The rest of the energy is exported to those undertakers whose generating stations have been shut down For this purpose the grid, which is at 132,000 volts, is tapped at certain points where the voltage is reduced usually to 33,000 volts and from which lines radiate throughout the district The tapping of the grid is an expensive matter, costing at least £40,000, and cannot therefore be done merely to give supplies to individuals A breakdown at any station or an exceptional demand can at once be met by the resources of the pool The difficulties in the way of progress are connected with wayleaves, obtaining consents to the erection of overhead wires from local authorities and from the Council for the Preservation of Rural England Cases arise where the question of amenities has to be weighed against economic and utilitarian considerations The question is whether the boon of an electric supply will outweigh a limited interference with local amenities

Some interesting suggestions for the development of the resources of the British Empire have been put forward by Sir Robert A Hadfield in a pamphlet entitled, "Organised Empire Development", and in an article in *Canada* on "Making Empire Development a Business Proposition" As is well known, Sir Robert Hadfield advocates the formation of an Empire Development Board, non political and non-fiscal in character, which would investigate opportunities for trade and industrial development throughout the Empire This Board would be a permanent organisation, meeting more frequently than the Imperial Conference, and would consist of representatives from all parts of the Empire, devoting their whole time and energies to its work Meetings would be held in Great Britain and the various Dominions in rotation, and by this means the members would obtain first hand knowledge and experience of the conditions, requirements, and possibilities of the different parts of the Empire

In conjunction with the proposed Empire Development Board, Sir Robert Hadfield suggests that a large Imperial Development Fund should be raised which would be utilised by arrangement with the various governments to develop the productive capacities of the constituent parts of the Empire Among the first aims of the Board should be the promotion of the development of more efficient transport, the foundation of new industries, the initiation of hydro electric power schemes, the encouragement of agriculture and the control of forestry Attention should also be especially devoted to the economic development of the Crown Colonies, since in these areas raw materials in abundance can be obtained Another interesting suggestion put forward by Sir Robert Hadfield is that Empire settlers should be given opportunities to revisit the home country periodically This, he holds, would do a great deal to cement the ties of Empire

It is well to remind ourselves occasionally that there are technical colleges in Great Britain which are doing higher and more valuable work than teaching 'engineering arithmetic' or 'commercial English' to pupils who have left school without having acquired sufficient knowledge of arithmetic or English to do a simple calculation correctly or to write an intelligible letter, and who can only be tempted to further study by a title suggesting that a very little of an educational subject is sufficient for industrial or commercial life The January issue of the *Journal of the Royal Technical College*, Glasgow, gives ample evidence of the value for science and industry of the work which is being done at this institution It consists of more than 200 pages of research work carried out in the College by the staff and senior students and communicated to the *Journal* during the last six months of 1929 More than 80 pages emanate from the mechanical laboratory, 50 from the bacteriological, and the rest from the mathematical, chemical, physical, and pharmaceutical laboratories One cannot read these papers without realising the importance of the work which is being done in institutions of the type of the

Royal Technical College in the supervision and direction of present research and in training men for the research of the future

THE value of joint effort in scientific work is well illustrated by the success of the Southern Eastern Union of Scientific Societies The Union now consists of sixty-four societies interested in antiquities, architecture, botany, geology, natural science, photography, and the less circumscribed pursuits of field and rambling clubs, and in these it embraces more than sixteen thousand members It is probably not too much to say that few of these societies, standing by themselves, would accomplish much original work, but under the stimulus and organisation of union they have succeeded in doing well for the investigation of the south east of England The thirty third annual report, which appears for the first time with the title of the *South-Eastern Naturalist and Antiquary*, contains the papers read at the Brighton Congress of 1929—Sir Arthur Keith's presidential address on "The Pre Roman Inhabitants of Southern England", and the addresses of the presidents of sections But it also shows that the botanical section is compiling a complete flora of Sussex, and that the geological and archæological sections are alive to the need for collecting and recording local information and the discovery of objects of scientific interest This year's Congress is to be held at Portsmouth under the presidency of Mr O G S Crawford

AN interesting and important piece of evidence for the existence of the creature popularly called the 'sea serpent' has recently come to hand in the shape of a letter in which Capt F W Dean, R N (retired) describes a creature seen by himself and several of the officers and men of H M S *Hilary* in May 1917 He relates the incident as follows "About 9 A M on approx 22/5/17, H M S *Hilary* was some 70 miles S E of the S E part of Iceland, the day very fine and clear, the Iceland mountains in sight, flat, calm, and smooth sea An object was observed on starboard quarter The ship was turned round and steered straight for the object When we were about a cable (200 yards) from it the creature quietly moved out of our way and we passed it on our starboard side at a distance of about 30 yards, getting a very good view of it As we passed close to the creature it lifted its head once or twice as if looking at us The head was in appearance black and glossy, with no protrusions such as ears, etc, in shape about that of a cow the top edge of the neck was just awash, and it curved to almost a semicircle as the creature moved its head as if to follow us with its eyes The dorsal fin was a black equilateral triangle which rose at times till the peak was estimated to be four feet above the water"

THREE independent estimates made on board the *Hilary* gave the length of the neck of the 'sea serpent' (head to dorsal fin) as 15 feet or more, 20 feet, and 28 feet. The head appeared to have a patch of whitish flesh in front, "like that around a cow's nostrils" The dorsal fin was thin and flexible, occasionally curving over at the top The *Hilary* being on patrol at the time, the unfortunate creature was used as a target for anti submarine practice with the 6 pounders, at about 1200 yards range A direct hit having apparently been scored, it disappeared, no trace remaining A few days later (May 25, 1917), the ship was torpedoed and sunk, taking with her all logs, journals, etc, recording the 'sea serpent' incident As described, the creature seems to have borne a most striking resemblance to that seen off the Brazilian coast, in December 1905, from the Earl of Crawford's yacht *Valhalla* (see NATURE, June 28, 1906, p 202) This, also, exhibited a dorsal fin rising some four feet out of water, and a long, snake like neck, terminating in a head described as resembling that of a turtle In this case, the head and part of the neck were lifted well clear of the water, and not merely floating awash In both cases there seems no doubt that the observers saw a single living sea creature of unknown species

THE Journal of the American Museum of Natural History, New York, entitled *Natural History*, is the most successful popular museum magazine with which we are familiar, from the point of view alike of its matter and of its circulation The half dozen parts which form the volume for 1929 are remarkable for the variety of their interest, for the skill of the contributors in composing articles containing much now information expressed in easy language, and for the excellence and lavishness of the illustrations Where so much is excellent it is difficult to particularise, but one of the series most interesting to naturalists must be the descriptions and restorations of prehistoric animals recently discovered in America or in other parts of the world by the Museums' expeditions The final number for 1929, for example, contains an account, with photographs of the actual skeletons and of a restoration model, of a herd of Miocene camels (*Stenomylus hitchcocki*), discovered entombed near Agate Springs in Western Nebraska The cost of running so sumptuous a museum journal must be enormous, but the return, represented by interest taken in the Museum and its doings, must also be great, and much can be done with a membership numbering more than eleven thousand

SOME interesting data emerge in a study of the statistics of cancer in England and Wales, which have been published by M Pittard in the *Bull et Mém de la Société d'Anthropologie de Paris*, Ser 7, T 9, Fasc 4 5 6 This study is supplementary to an appendix in the Report of the Cancer Commission of the League of Nations and revises certain of the figures of distribution in that appendix Its chief interest, however, lies in the fact that M Pittard has here endeavoured to correlate the data of cancer and race He finds that the highest death rate from cancer for ages above forty five occurs in two groups of counties, (1) Montgomery and Merioneth in Wales, and (2) Rutland, Peterborough (Lincoln), Isle of Ely, Suffolk, Lincoln (parts of Holland), and Huntingdon On turning to the anthropological data, he finds that a high cancer rate is found with the higher figures for stature, and with the more pronounced dolichocephaly, but that in the case of pigmentation the figures are

contradictory, though certain of the data point to a coincidence of a high rate of cancer mortality and a high degree of nigrescence These conclusions are interesting for what they are worth M Pittard is well aware how far they fall short of a scientific standard The anthropological data upon which his conclusions are based are utterly inadequate In the case of pigmentation, there are whole areas for which he could obtain no data for his purpose, and he points out how completely Great Britain falls behind Germany, for example, in a knowledge of the physical type of its population Cancer, however, is but one of the more important of the numerous problems of which the scientific study is handicapped by the fact that no complete anthropometric survey of the British population has ever been made

At the annual general meeting of the Society of Public Analysts, held on Mar 5, the following officers were elected *President*, Dr J T Dunn, *Hon Treasurer*, Mr E B Hughes, *Hon Secretary*, Mr F W F Arnaud

The eleventh International Congress of Zoologists will be held at Padua on Sept 4–11 next, under the presidency of Prof Paolo Enriques It will be followed by two or three days' excursion to the valleys of Comacchio, Ferrara, Bologna, and Ravenna The office is at Padova, Via Loredan 6

Engineer Vice Admiral Sir Robert Dixon, president of the Institute of Marine Engineers, and Dr H J Weld, organiser of the Weld Ashmolean Expedition to Kish, have been elected members of the Athenæum Club under the provisions of Rule II of the Club, which empowers the annual election by the Committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public service

Dr Irving Langmuir, associate director of the General Electric Company's research laboratory at Schenectady, has been awarded the Willard Gibbs gold medal of the Chicago section of the American Chemical Society, " for fundamental work on atomic hydrogen and on surface relations and also on electrical discharge phenomena Also for his contributions of great importance to nearly all branches of physical chemistry, including high vacuum technique, electronics, thermochemistry, and catalysis And lastly, for his presentation of a theory of atomic structure "

In 1932 it will be a hundred years since the death of Goethe and fifty years since that of Darwin Goethe, it will be remembered, was a native of Frankfurt a/M, and Prof Fritz Drevermann proposes to arrange in the Senckenberg Museum there, of which he is director, an exhibition in commemoration of these two great men He would be glad to borrow for that purpose any objects personally connected with Charles Darwin, especially a page of his handwriting, and he urges that as a means of inducing friendship between the nations this last would have more value than " a scrap of paper "

Early this year it was announced in the daily Press that Prof A A Michelson, the distinguished physicist of the University of Chicago, had died, and we were glad to be able to contradict this report promptly and authoritatively Congratulations are now due to Prof Michelson on the recent award to him by the Council of the Physical Society of London of the Duddell Medal for 1930 This award, it will be remembered, is made annually to some one who has contributed to the advancement of knowledge by the invention or design of scientific instruments or by the discovery of material used in their construction Scientific workers generally will agree that this new tribute to Prof Michelson's genius has come at a particularly happy time

The Report of the Haffkine Institute, Bombay, for 1928 records that nearly two million doses of anti plague vaccine were issued, and 276,095 rats were examined for plague infection, of which 2222 were found to be infected At the anti rabic department, 718 persons were treated, of whom 6 died, a mortality of 0 83 per cent

By arrangement with the proprietors of *The Quarterly Journal of Mathematics* and *The Messenger of Mathematics*, the Oxford University Press will, after Mar 31, continue both journals by a single successor in new format, to be called *The Quarterly Journal of Mathematics (Oxford Series)*, and to appear quarterly, commencing in April next

Under the Local Government Act, 1929, the functions relating to public vaccination in England and Wales hitherto discharged by Boards of Guardians will, from the appointed day (April 1, 1930), be transferred to other bodies The Ministry of Health has, therefore, issued an explanatory leaflet (*Circular* 1067) to guardians of unions extending into more than one area, and to the county and other councils who will assume the functions of the guardians, a statement of the main statutory provisions governing the vaccination service (*Memorandum*, L G A 33, 2d) The Minister of Health has also issued an Order (Order No 73,990 Statutory Rules and Orders, 1930, No 2 9d net) consolidating and amending the orders made from time to time under the Vaccination Acts, 1867 to 1907 with a covering circular (*Circular* 1068) All these publications are issued by H M Stationery Office

The latest catalogue (No 341) of Messrs W Heffer and Sons, Ltd, Cambridge, to reach us contains particulars of some 2500 second hand works, mainly relating to the classics and classical archæology, from the libraries of the late H V Macnaghten and R D Hicks

Applications are invited for the following appointments, on or before the dates mentioned —An assistant master, graduate in engineering, at the Ashton under Lyne Junior Technical School—G W Handforth, Education Offices, 8 Warrington Street, Ashton under Lyne (Mar 29) A sanitation officer for Barbados—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S W 1 An assistant radiologist at London Hospital —The House Governor, London Hospital, E 1 (Mar 29) An organic chemist as research assistant

at the East London College—Dr A Robertson, East London College, E 1 (Mar 30) Scientific officers and junior scientific officers under the Directorate of Scientific Research of the Air Ministry—The Chief Superintendent, R A E, South Farnborough, Hants (April 5) An assistant in the Jodrell Laboratory at the Royal Botanic Gardens, Kew—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S W 1 (April 7) An assistant lecturer in mathematics at the University College of Hull—The Secretary, University College, Hull (April 14) Professors of botany, and geography and anthropology, at the University College of Wales, Aberystwyth—The Secretary, University College of Wales, Aberystwyth (April 23) A lecturer in palæontology and stratigraphy, two lecturers in geography, and a demonstrator in inorganic and physical chemistry, at Bedford College for Women—The Secretary Bedford College for Women, Regent's Park, N W 1 (April 24) Three assistant inspectors of ancient monuments under the Commissioners of His Majesty's Works and Public Buildings—The Establishment Officer, H M Office of Works, Westminster, S W 1 (May 16) A radiologist at the Wellington General Hospital, New Zealand—The Secretary, Wellington General Hospital, Wellington, New Zealand (May 20) Two assistant physicists, one a woman, under the Research Association of British Paint, Colour, and Varnish Manufacturers—The Director, Paint Research Association, Waldegrave Road, Teddington A sanitary inspector under the Sudan Medical Service—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S W 1 A radiologist at the Mount Vernon Hospital—The Secretary, Mount Vernon Hospital, 7 Fitzroy Square, W 1 A woman assistant under the Air Ministry, Kidbrooke, for Aeronautical Inspection Directorate Test House—Secretary, I E 2, Air Ministry, W C 2

Our Astronomical Column

New Comet, 1930 *b*.—The second cometary discovery of the year was made at Hamburg on Mar 11 by Mr Beyer, the magnitude was given as 10½, but as the object was seen in bright moonlight it may have been brighter than this Subsequent search of plates exposed by Dr Prager at Neubabelsberg, Berlin, revealed images The following positions are from telegrams from the I A U Bureau, Copenhagen

	U T		R A	N Decl	Observer	Place
Mar	2^d	21^h $59{\cdot}0^m$	6^h 8^m $12{\cdot}86^s$	28° 3′ 5″	Prager	Berlin
	8	21 11·0	6 7 40·53	28 32 2		
	11	20 30·5	6 5 20	32 22	Beyer	Hamburg
	13	18 49·9	6 5 11·33	33 14 2	Bianchi	Milan

The comet is well placed in the evening sky, and should be within reach of moderate instruments

M Ebell has computed the following orbit and ephemeris of Beyer's comet, they have been telegraphed from the I A U Bureau

$$\begin{array}{ll} T & 1930 \text{ April } 22{\cdot}212 \text{ U T} \\ \omega & 26° \quad 41' \\ \Omega & 116 \quad 26 \\ i & 71 \quad 28 \\ \log q & 0{\cdot}31385 \end{array}$$

EPHEMERIS FOR 0^h

	R A	N Decl
Mar 21	6^h 5^m 56^s	36° 13′
25	6 7 12	37 45
29	6 9 8	39 11

There does not appear to be any sensible deviation from a parabola in the orbit of comet 1929 *d* (Wilk) Mr F E Seagrave deduced an orbit from observations extending over five weeks, which indicated a period of 20,000 years

Mars in 1926.—Prof W H Pickering has for many years published in *Popular Astronomy* reports on the successive apparitions of Mars His report on the 1926 apparition appeared in December last Thirty six drawings by eight different observers are reproduced These are arranged in groups some 60° apart in longitude, so that drawings of the same region are grouped together While there are large differences in style, the drawings of the separate observers to a large extent corroborate each other, some differences are due to real changes on the planet, produced by clouds, or precipitation from them The great majority of the canals on the drawings are confirmed by different observers, though some draw them much narrower than others The total number of canals drawn was 189, of which 139 were confirmed by other observers The lakes seem less certain, 110 were drawn, but only 69 confirmed Prof Pickering notes that the apparition of 1928 was probably the worst observed one in modern times, still he exhorts observers to send him such drawings as they were able to make, as it is undesirable in the interests of continuity that it should pass unrecorded

The Zodiacal Light.—Two interesting notes about the appearance of this phenomenon have come to hand In *Astr Nach*, 5684, Mr I Yamamoto reports the observations of two Japanese astronomers, K Araki and T Kamei, on the morning of Nov 3, 1929, the former noted that at 76° from the sun its width exceeded 40° and its brightness was twice that of the galaxy in Auriga The latter noted that at 80° from the sun the width was 23°, and the brightness five times that of the galaxy in Monoceros Nearer the sun it appeared to be narrower and fainter, that may be due to lower altitude Twilight had not begun at either station The axis of the light lay very near the ecliptic according to Mr Araki, Mr Kamei noted that the base was on the ecliptic, but the apex some 6° to the south of it

In a letter to the Editor, Mr C T Jacob, stationed at Tuticorin, South India, states that about local midnight on the night of Jan 30–31, 1930, the zodiacal light was visible simultaneously in the east and in the west, the appearance was that of two nebulous triangles, the apices of which pointed to the zenith, the western triangle was brighter and better defined than the other The sky was so clear that the Milky Way could be traced right down to the horizon in the south Mr Jacob notes that there are no powerful artificial lights in his neighbourhood that could have given rise to the glows that he describes

The late Mr E W Maunder, in his account of the eclipse expedition of January 1898, noted that the zodiacal light was frequently very conspicuous in India

Research Items.

The Earliest Bantu.—The problems of the Bantu languages and the light they throw upon the earliest culture of the Bantu speaking peoples are discussed by Dr N J v Warmele in *Africa*, vol 3, No 1 The Bantu languages constitute a group of exceptional uniformity both in grammar and vocabulary, which indicates that they are derived from one clearly distinct form of speech From the comparative study of living Bantu dialects, philologists have reconstructed archaic or Ur Bantu From this may be deduced a knowledge of the ideas and the culture, and perhaps the place of origin of the ancient Bantu The roots now accepted as belonging to the Ur-Bantu tongue number nearly a thousand These indicate that the original home of the early Bantu was by a lake (root *yangja*, for example, Nyassa, Nyanza) Neither the names of animals nor plants are helpful, as they are too widely distributed throughout the whole continent, but the roots for the names of animals exclusively African are widely spread, so that the Ur-Bantu were familiar with them from an early date If, therefore, they came from Asia, it must have been before their language began to split up, and the infancy of Ur Bantu may safely be laid in Africa As regards the nature of their culture, the root *Yombe*, meaning cattle, is of wide distribution, and cattle must therefore have been known long ago But in South Africa the root for cattle, *Komo*, is related to the Hottentot *goma b*, *kumamb* Further, it is only in the South African languages that the root for sheep occurs to any extent, suggesting that the Bantu obtained their sheep from the Hottentot The widely distributed terms for breeding or rearing apply only to cattle On the other hand, the Bantu were not cattle breeders simply, and a similar examination of the roots indicates that agriculture also played a part in the economic life of the people The grain with which they have been longest acquainted is millet, and their agricultural implement the hoe The evidence would also point to the fundamental religious conception as being taboo Although *túla*, 'to forge iron', is common, there is no term for iron, and the word *túmbi* in use in South Africa also means cowrie, so that apparently iron was not known to the early Bantu, and when introduced was used through barter, and primarily served the purpose of currency and ornament only

Vocational Guidance in Schools.—In the *Journal of the National Institute of Industrial Psychology*, vol 5, No 1, there is a suggested scheme for the organisation of vocational guidance in schools It is no longer necessary to defend vocational guidance as such, its value in numbers of cases has been well established There is, however, the very practical problem of providing assistance in the selection of a career for large numbers The article suggests that in every school there should be one person whose recognised duties should include the vocational guidance of the children He should work in consultation with his colleagues, the parents, and the school medical officers As, however, no one person could obtain all the necessary information about all possible careers and industrial facilities, his work should be supplemented by that of a visiting vocational adviser, who should be responsible for the vocational guidance work in all the schools in his district He should be the originator of new lines of inquiry, of experimentation with new tests The suggestions put forward in the article are worthy of serious consideration

Inheritance of Natural Immunity.—The literature on natural immunity in animals and its inheritance has been summarised by Mr A W Kozelka (*Jour of Heredity*, vol 20, No 11), who points out that immunity to a particular disease may be characteristic of a species, a race, or an individual Many curious cases of specific and racial immunity are cited The immunity of the frog to anthrax is at least partly due to the phagocytic activity of its leucocytes, while the blood serum of animals often has a bactericidal effect The alligator is immune to tetanus because of a natural antitoxin in its blood Such human diseases as diphtheria, typhoid, scarlet fever, measles, and yellow fever are not found in animals Larvæ of the rhinoceros beetle were found by Metchnikoff to be susceptible to cholera but immune to anthrax and diphtheria, while crickets are readily susceptible to anthrax Among related species, *Anopheles maculipennis* carries malaria, while *A punctipennis* is immune Negroes are relatively immune to yellow fever, and Japanese to scarlet fever Negroes are very susceptible, and urban Russians, Poles, and Jews much more resistant to tuberculosis Measles is a fatal disease among various native races Such racial differences have probably resulted from natural selection through long exposure to the disease Among domestic animals, the Algerian sheep is the only breed not susceptible to anthrax Zebu cattle are apparently unaffected by foot-and mouth disease, anthrax, and Texas fever, and the immunity is transmitted in some degree in hybrids with ordinary cattle The Japanese waltzing mice are susceptible to implanted tumours, while the degree of resistance in house mice varies greatly in different localities Many rats are immune to plague Some 50 per cent of human beings and 30 per cent of horses are naturally immune to diphtheria By selection, strains of mice resistant to mouse typhoid can be produced, or of guinea pigs resistant to tuberculosis In many of these cases several Mendelian inheritance factors appear to be involved

Fishes of the North Atlantic.—The International Council for the Exploration of the Sea, at the Copenhagen meeting in June 1928, decided to undertake the publication of an illustrated ichthyological fauna of the North Atlantic Parts 1 and 2 of this work have now appeared ("Faune ichthyologique de l'Atlantique Nord" Conseil Permanent International pour l'Exploration de la Mer (Publiée sous la direction de M le Professeur Joubin) N p n d) It is published in the form of loose cards made up in sets of 24 Each set or part is enclosed in a folder, and the entire work is expected to run to about 15 parts One card is devoted to each species and contains, in addition to one or more illustrations, a clear and precise description of the fish, its geographical distribution, synonymy, and a short bibliography The legend is written—in English, German, or French—by specialists on the group or family concerned, and each card is signed by the author Some of the illustrations are original, others are reproduced from standard works It seems unfortunate, however, that more original illustrations are not being produced, especially when some of those copied from elsewhere could be replaced by better illustrations

Mammals of Buru, Moluccas.—For the first time a list of the mammals of Buru has been published, and it reveals a fauna of unusual interest (Dr K. W

Dammerman in *Treubia*, Buitenzorg, vol 7, Suppl, December 1929) Of the 27 species recorded, 16 are bats, and of the four rats and mice, three are recorded for the first time from the island The most interesting species are undoubtedly the Moluccan deer (*Cervus hippelaphus moluccensis*) and the Babirussa Buru is the type locality of the former, although the race seems now to be very rare there, and may have been imported in former days Dr Dammerman regards Buru as the type locality also of the Babirussa, for although Linnaeus described the species as from Borneo, the older Dutch authors do not mention its presence there, and the Dutch name Boeroe for Buru may have led to confusion It is curious that, in spite of the frequency with which skulls of this species may be found in museums, the skin of the beast itself is so rare Even the museum at Buitenzorg has only an old and badly stuffed specimen from Celebes and a recent damaged skin from Buru The unexpected and localised distribution of the species on the island and the fact that it has no native name suggests that at one time it may have been introduced from Celebes, for Quoy and Gaimard stated that in former times the rajahs there kept and bred the babirussa in order to make presents of it The shortness of the skull and less straight profile of the Buru race may be, as in domestic pigs, indications of domestication

A New Japanese Oyster —Dr Haruo Seki has discovered a new species of *Ostrea* from Japan which he has named *Ostrea futamiensis* ("Description of a New Species of Oyster from Japan", *Proc Imp Acad Sci*, Tokyo, vol 5, No 10, 1929) This oyster is to be found with *Ostrea denselamellosa*, and has hitherto been regarded as a dwarf form of that species The new oyster, bearing the Japanese name of *Kuro himegaki*, has a much larger egg than *O denselamellosa*, although the shell in the adult is much smaller The spat is either uniformly black or striped with yellow The developmental stages take place within the mantle cavity until the free swimming straight hinge larval stage is reached, the larvæ when freed being found near the shore in the deeper water layers So far as has been observed, each individual spawns twice or thrice at intervals of from ten to twenty days during the spawning season, which lasts from the middle of June to the end of September

Taxonomy of Bryophyta —In "Honduran Mosses collected by Paul C Standley" (Field Museum of Natural History, Chicago, Pub 267 Bot Series, vol 4, No 9, 1929), Edwin B Bartram describes 178 mosses, representing 79 species and including four new to science, *Campylopus hondurensis*, *Bryum Standleyi*, *Bryum bursiforme*, and *Rhynchostegium patulum*, which are figured and described The data are too meagre for a discussion of geographic distribution, but Mr Bartram considers the evidence points to affinity with Mexico and the Antilles rather than with the types of Costa Rica and Panama It is suggested that *Isopterygium scalpellifolium* (C M) Broth should be restored to *Microthamnium*

Hybridism in the Forests of New Zealand —In no country is the knowledge of hybridism in the native flora so advanced or the recognition of its all-important bearing upon floristic and ecological botany so fully appreciated as in New Zealand, where Dr Cockayne's researches have done so much towards a proper understanding of its taxonomic significance In a recent paper (*Acta Forestalia Fennica*, 34, 1929), he gives details concerning the forest and semi forest hybrids, more than a hundred groups of which have been recognised. Cogent reasons are advanced for accepting the hybrids as valid, and in several cases hybrids have been synthesised which match those occurring in the field With one exception, so far as is known, all the hybrids are fertile, and the constant crossing and segregation which takes place results in the hybrid groups all occurring as big polymorphic swarms of individuals which have previously been either aggregated into so called 'variable' species, or segregated into inconstant varieties The rôle of the hybrids in the forest is discussed with reference to the number and relative abundance in the community of the hybrid groups and the life forms of the hybrid individuals which are present

Development of the Inflorescence in Cereals — Very valuable data on this subject are provided by Yakichi Noguchi for Japanese cereals in a paper in the *Journal of the College of Agriculture*, University of Tokyo, 10, 247 303, 1929 Detailed measurements of the inflorescences at various stages are supplied, together with details of morphological development for six spring sown and four winter sown cereal types under Japanese conditions A study of the rice plant's development under various conditions of cultivation shows that the developmental characteristics vary very little, which adds force to the general conclusion that spring and winter sown types show very different types of development In all the cereals the initials of the reproductive organs are already to be detected in the embryo in the mature grain In the spring sown types, a very slow growth of the panicle initial occurs for the first 40 50 days, and during this time the morphological changes in the growing point are negligible Growth and differentiation then start suddenly and proceed very rapidly until the panicle emerges from the bud In the winter sown types, on the contrary, shortly after sowing, floral parts begin to differentiate in the panicle initial, although growth is slow for the first 120 150 days Then rapid growth begins and proceeds for some 65 days longer, when the panicle emerges from the bud No correlation was found between the vigour and period of vegetative development, and the processes of floral differentiation and development, on the other hand, a large grain showed correlation with a large embryo and a large embryo with the degree of differentiation of the floral rudiments within it On the basis of a comparison of the growth and development of their floral organs, Noguchi would put rice, sorghum, panicum, and setaria into one group wheat, rye, barley, and oats in another, with maize yet another distinct type The data supplied in this paper are very full and valuable, and will well repay close study

Salinity Investigations in the South African Seas — Mr Marchand has shown (*Fisheries and Marine Biological Survey* Report No 6 For the Year 1927–28 Special Report No 4 Pp 1-21) that water samples can be analysed within three months without any appreciable inaccuracy in the results, and confirms Dr Gilchrist's statement that "the Mozambique Current, which has been subjected to the evaporation of the equatorial regions, contains a greater percentage of salt than the Antarctic waters" which is known as the Benguela Current on the west coast This difference in salinity has not been observed to have a direct effect on life in South African seas, but the existence of waters of different temperature and salinity side by side forms an effective barrier to some animals

Echo Sounding and Depths —In an article on echo sounding in the *Hydrographic Review*, vol. 6, No. 2, Dr H Maurer raises a practical issue of much import

ance In order to calculate the true echo distance, obtained by a sonic sounder, the mean velocity of sound between the ship and the bottom must be known The velocity varies with temperature, salinity, and pressure Tables for conversion of echo distances to depths are issued by the Admiralty (H D 282), and comparisons made by the German vessel *Meteor* in recent work in the South Atlantic showed that the use of these tables gives fairly accurate results in cases where the depths was ascertained by both echo and wire Yet out of 245 comparisons of depths of more than 2000 metres, 36 gave a difference exceeding 100 metres and the maximum difference was 650 metres The echo gives, of course, the distance to the nearest point on the bottom, and not necessarily the vertical depth Since depths are frequently important in finding position, Dr Maurer suggests that the echo distances should be entered on the chart The crude echo distances, converted on a single constant velocity, are the most useful to the seaman and also for scientific purposes since it is then possible to convert them by the latest data available Results of echo sounding given in depths without any indication of the velocity on which the depths are based or of attempts to rectify oblique distances are practically useless and may be misleading

A New Lamp —The February issue of the *General Electric Review* contains a description of a new form of electric lamp, in which an arc and filament are operated together The arc passes between terminals of tungsten in an atmosphere of mercury vapour and pure argon, and the filament, a V shaped spiral of tungsten, is connected internally in the same bulb between the electrodes of the arc In the lamp for which details are given, about two thirds of the light emitted comes from the tungsten electrodes, and one quarter from the arc, the remainder being presumably from the filament The colour temperature of the light is greater than 3500° absolute The tube passes a current of about 30 amperes at 11 volts, and is self starting Ultra violet light of physiological value has been conserved by making the bulb of a special iron free glass, which is partially transparent down to a wave length of 2800 A

The Charge of an Electron —Prof A S Eddington's derivation of the amended number 137 for the atomic constant $hc/2\pi e^2$ is given in a paper entitled "The Interaction of Electric Charges" in the March number of the *Proceedings of the Royal Society* As he indicated in his letter to NATURE on this problem (Nov 30, 1929, p 840), the mistake in his earlier theory (see NATURE, Jan 26, p 138, and Feb 2, p 174, 1929) consisted not so much in overlooking that degree of freedom of a pair of electrons which has no counterpart in the theory of a single electron—alteration of the proper distance between the two—as in not recognising its distinctness from the others Whether or not the best *experimental* value of the constant is 137 is still perhaps an open question In addition, by making definite assumptions as to the physical significance of certain transformations and results of quantum theory, Prof Eddington has traced down the distinction between space and time to properties of matrices, the matrix theory predicts that one dimension of the world will be related to the other three by Lorentz transformations instead of by rotations Still another tentative line of argument points to an origin of the loss of mass which occurs in such cases as the formation of the nuclei of atoms, in the loss of a degree of freedom when charges link up to form a *perfectly rigid* system Prof Eddington's aim in this paper has been to substitute a more satisfactory geometrical basis for the appeals to the analogies of classical dynamics which occurred in his earlier theory, but he expresses the opinion that finality has yet to be attained

Iridescent Colours in Nature —The discourse on iridescent colours given by Lord Rayleigh at the recent exhibition of the Physical and Optical Societies at the Imperial College of Science has been published in full —apart from the illustrations—in the February number of the *Journal of Scientific Instruments* The objects dealt with were chiefly butterfly wings, beetles, and the eye of a peacock feather That the colours of butterflies are partly due to absorption and partly due to interference is well established, but the origin of the colours of an iridescent beetle has been a matter of controversy The facts presented by Lord Rayleigh seem to establish that they are due to interference in a laminated structure, and not to surface reflection, for quite apart from the variation of the colour with the angle at which the beetle is viewed, the characteristics of the banded spectrum of light transmitted by a specimen are those of an interference spectrum All the observations mentioned by Lord Rayleigh are not yet completely explained, however, in particular, the bleaching of what are apparently interference colours by exposure to ultra violet light, or even to sunlight, calls for further investigation, and especially the complicated behaviour of the peacock's feather, in which, under such treatment, certain zones have their reflecting power for red light *increased*

Origin of Protoactinium —The January number of the *Journal of the American Chemical Society* contains an important paper by J E Wildish on the separation of tantalum from different uranium ores, this element being the nearest homologue of protoactinium The uranium and protoactinium contents of five uranium ores from widely separated localities were determined and the atom for atom relation between uranium and protoactinium computed in each case The results show that the ratio in different ores is very different, and consequently lend support to the hypothesis that the actinium series originates from some other source than uranium II

Ignition of Hydrocarbons in Oxygen —It is now generally recognised that paraffin hydrocarbons react readily with oxygen at comparatively low temperatures In the January number of the *Journal of the Chemical Society*, J S. Lewis describes some experiments in which mixtures of hydrocarbon vapour and oxygen were heated in glass bulbs until explosion occurred It was found that in dilute mixtures explosion could not be produced, but extensive oxidation had occurred at about 235°, and the rate of heating was also important The minimum percentage for ignition increased with the instability of the hydrocarbon towards oxygen With rich mixtures the explosion was not so violent the violence increased with reduction in hydrocarbon content until a maximum was reached when the ratio approaches that for complete combustion A more rapid rate of heating tends to raise the ignition temperature, a result not found with olefines In presence of powdered charcoal the ignition temperature of paraffin is raised, that of amylene considerably lowered In presence of lead tetraethyl the ignition temperature was raised, some times as much as 40° It is concluded that the explosion of hydrocarbons takes place in two stages, the explosion of the products of autoxidation (peroxides or chain reactions) followed by the combustion of the products in the excess of oxygen to oxides of carbon and water

The Articulation of a Telephone Circuit.

THE best method of testing telephone circuits and apparatus is a problem to which a great deal of attention has been devoted of recent years. Speech is carried over a telephone circuit by means of certain frequency components produced by the voice of the speaker at the sending end and received by the listener at the receiving end. If the components arriving at the listener's ear are exactly the same as when they left the speaker's mouth, the circuit would have a hundred per cent efficiency. There are two principal reasons, however, why the components arriving at the listener's ear are not the same as those leaving the speaker's mouth. In passing along the circuit the amplitude of the waves is attenuated, they thus become weaker. The amount of the attenuation also varies with the frequency, and hence the waves become distorted. Again, components which were not originally present are produced in the circuit. These are due either to noise or to the overloading of some part of the circuit. Their effect is to raise the threshold values at which the ear can hear different notes. In *Electrical Communication* for January, J. Collard gives a method by means of which the effect of given noises on the 'articulation' of a telephone circuit can be computed much more quickly than by the ordinary methods.

In the usual method of testing, a series of syllables chosen at random are spoken into the telephone, the listener writing down what he imagines he hears. The ratio of the number of syllables correctly received to the total number of syllables sent gives an indication of the quality of the circuit. Unfortunately, the value thus obtained depends not only on attenuation and distortion, which are produced by the circuit, but also on faulty pronunciation by the speaker and faulty hearing by the listener. The value, therefore, varies with the speakers and the listeners, a great number of tests have to be taken before we can tell what is the approximate mean value.

The author gives empirical formulæ by means of which the ideal sound articulation can be approximately computed. It is not affected by careless pronunciation by the speaker or inattentive hearing by the listener. Once a circuit has been set up, articulation tests can be made on it and the value of the articulation obtained, but there are many cases in which it is desired to know before installing a given circuit or before inserting a given piece of apparatus in the circuit what the articulation will be, and this can be found in a few minutes by the author's method.

It has been calculated that to obtain a value of the articulation with a probable error of one per cent, it is necessary to speak 5000 syllables into the circuit. If there are ten pieces of apparatus to be tested, this would mean that 50,000 syllables would have to be called. The usual rate of calling is 20 per minute. Taking into account also the time required for calibrating the experimenters the total time will be about 50 hours. The saving effected, therefore, by using the new empirical formulæ is a substantial one. In a previous paper published in *Electrical Communication* for January of last year, the author showed that articulation has much the same value whether English, French, German, or Italian be used. It appears, therefore, that his method is applicable to other languages with little, if any, modification.

Whaling and Fishing in the North Atlantic[1]

IN the autumn of 1923 the Norwegian Government appointed a whaling committee, under the chairmanship of Dr Johan Hjort, to carry out a scientific study of whaling and of the various factors in the sea which govern the life and migrations of whales. This committee at once approached the British Discovery Committee with a proposal that the two bodies should co-operate in this work. As a result of the negotiations which followed, it was agreed that, at any rate to begin with, the best arrangement would be for the *Discovery* to operate on the Antarctic whaling grounds, especially those worked from the Falkland Islands Dependencies, while the Norwegian investigators concentrated upon work in the North Atlantic.

In accordance with this agreement, a number of investigations have been carried out in northern seas during the years 1924–1928 under the administrative direction of the Norwegian whaling committee, the results of which have now been published in a very full report of some 550 pages. This report, although entitled "Whales and Plankton in the North Atlantic", deals not only with the occurrence and distribution of whales and their food but also with the occurrence and habits of the various species of fish of economic importance.

The two great sea areas lying west of Greenland (Davis Strait) and to the eastward of it (Norwegian Sea) have been studied in detail. Reference is made at the outset to two cruises made by Jensen during the summers of 1908 and 1909 in the brig *Tjalfe*, when that indefatigable investigator prospected for fish along the entire western seaboard of Greenland, including fjords, inshore waters, banks, and deep sea—a vast tract extending from 60° N. to 71° N. Along this enormous distance the distribution and biology of all the more important edible fishes were investigated, and the fact established that the very limited fishery of this region is due not to the absence of marketable fish but to the primitive equipment of its fishermen and their difficulty in disposing of their catch. There is an abundance of good fish, including common cod, fjord cod, halibut, Greenland or black halibut, the long rough dab, and two species of catfish.

During the years 1924–28 fishing expeditions to Davis Strait, financed by Messrs. I. O. and O. S. Hellyer of Hull and led by Mr. Engvald Baldersheim of Bergen, have proved extraordinarily successful, and form striking examples of what can be done to solve the difficult problems of organisation involved in fishing in very distant seas. To this region Hjort proceeded in the research vessel *Michael Sars* in 1924 and there carried out exhaustive fishing and hydrographical investigations.

The course of modern whaling is traced from the time of its initiation by Svend Foyn in Finland about the year 1870 until the present day, when its operations extend to almost all the waters of the globe. In a section written by Andr. Ingebrigtsen, himself a practical whaler of more than thirty years' experience, it is shown that with few exceptions the commercial pursuit of the whale sooner or later reduced the stock so greatly that whaling had to be abandoned either temporarily or permanently as unremunerative. Convincing details of the growth and decline of many whale fisheries are given. From about the year 1880 onwards, a number of whaling stations were established along the coast of Finmark and the number of boats rapidly increased from four in 1880

[1] Whales and Plankton in the North Atlantic (a contribution to the work of the Whaling Committee and of the North Eastern Area Committee). Conseil Permanent International pour l'Exploration de la Mer. *Rapports et Procès-Verbaux des Réunions*, Volume 56. Pp. 551. (Copenhague: Andr. Fred. Høst et Fils, 1929.) 21.50 Kr.

to thirty-four in 1885 The fatal result of this increase in the intensity of the fishery was soon apparent, for after about the year 1900 whaling at most of the Finmark stations ceased to pay and steadily declined In 1905 most of the companies transferred their headquarters to Bear Island and Spitsbergen, but there too the industry was not of long duration Too many boats destroyed the fishery, and by 1910 fishing in these waters was entirely abandoned Subsequent attempts to revive the industry at Spitsbergen in 1920 and 1925-26 proved ruinous to the companies concerned

Whale fishing off Iceland commenced about the year 1890 with eight whaling vessels The catch at first was good and the number of boats increased to thirty in 1902 Thereafter there followed a steady decline in the catches One station after another had to close, and Iceland whaling ceased altogether in 1915 The history of the whale fishing at the Faroes is in many ways similar to that of Finmark and Iceland As the number of boats increased the catch per boat greatly decreased, and many stations ceased to operate But during the War whaling stopped to a large extent This proved good for the stock, and post War catches off the Faroes, with fewer boats as compared with the number employed before the War, have yielded reasonable profits

The same tale of rapid initial growth and subsequent decline is told of whaling in the Straits of Gibraltar, off South Africa, and on the west coast of America, and in a final sentence Ingebrigtsen states his firm conviction that the great modern extension of whaling in the Antarctic will undoubtedly, in spite of its vast tracts of ocean and apparently enormous numbers of whales, produce in the course of some years the same results as in all other waters—namely, a decreasing stock of whales from year to year G A S

University and Educational Intelligence

CAMBRIDGE —At King's College the following have been elected to Fellowships Mr A E Ingham, reader in mathematics at the University of Leeds, and Mr R F Kahn, Wrenbury Scholar (1928) and Adam Smith prizeman (1929)

CARDIFF —H R H the Prince of Wales will visit Cardiff on May 21 to open the new chemistry and physics wing of the University College, and the Department of Public Health of the Welsh National School of Medicine

Mr H J Phelps has been appointed as assistant lecturer and demonstrator in physiology

EDINBURGH —On the recommendation of the Faculty of Medicine, the Cameron Prize for 1930 has been awarded to Dr George R Minot, physician in chief, Collis P Huntingdon Memorial Hospital of Harvard, Boston, Mass , and Dr William P Murphy, assistant physician, Peter Bent Brigham Hospital, Boston, Mass , conjointly, for their work on the liver treatment of pernicious anæmia

The Senatus has resolved to offer the honorary degree of doctor of laws to the following, among others Sir Thomas Barlow, Physician Extraordinary to H M the King , Sir Otto Beit, trustee of the Rhodes Trust and founder of the Beit Memorial Fellowships for Medical Research , Sir William Hardy, director of food investigation, Department of Scientific and Industrial Research , Sir David Wallace, consulting surgeon to the Royal Infirmary, Edinburgh , Prof. W W Watts, professor of geology, Imperial College of Science, South Kensington , Prof K F Wenckebach, emeritus professor of medicine, University of Vienna

Historic Natural Events.

Mar 23, 1233 Thunderstorm and Floods —There was a great and terrible tempest of thunder, and after followed a marvellous wet summer with many floods

Mar 23, 1913 Electrical Storm —An usually severe electrical storm occurred in the western part of Kansas, U S A High winds were blowing from south west or west, and the air was warm, very dry, and filled with dust , there was no rain Windmills, especially steel mills mounted on wooden supports, became so highly charged with static electricity that anyone touching them received a distinct, sometimes a severe shock At Tribune, sparks two or three inches long were drawn from a wire running to a windmill Telephone and telegraph wires and wire fences also became charged, and in Scott County, where the disturbance was most severe, a prairie fire is thought to have been started by sparks at a break in a wire fence, as in several places distinct sparks were noted on holding the broken ends of wire fences together In Thomas County all green vegetation was killed, and in Sheridan County the wheat turned brown The sky was obscured by a leaden or copper coloured haze, and most people experienced nervous depression

Mar 24, 1878 *Eurydice* Squall —A V shaped trough of low pressure crossed England from north west to south east, and with its passage the wind changed from a moderate westerly breeze to a north westerly gale The wind velocity was not especially great, but there were some violent north-westerly squalls with sleet or snow, during one of which the training ship H M S *Eurydice* foundered with all hands off Dunnose Head, near Ventnor The loss of life was about 300

Mar 24, 1895 Gale —This was described as the worst gale of the nineteenth century in the English Midlands At 8 A M , a well marked depression was centred over the Shetland Isles, and during the afternoon a small but intense secondary depression traversed England and Wales with a velocity of 58 miles per hour The greatest destruction was caused by a south westerly gale along a narrow belt (only 30 50 miles in width) to the right or south east of the track followed by the centre of the secondary Very great damage was done to property, many churches were injured and thousands of trees uprooted, and several lives were lost In the observatory at Birmingham the oscillation of the building stopped the clock

Mar 25, 1241 Drought —It is recorded in Matthew Paris's Chronicle that "From the Annuciation to SS Simon and Jude (Mar 25-Oct 28), continued drought and intolerable heat dried up deep lakes and extensive marshes, drained many rivers, parched up the warrens, and suspended the working of mills, hence the pastures withered away, herbage died, and consequently the flocks and herds pined away with hunger and died"

Mar 26, 1812 Earthquake in Venezuela —The town of Caracas was utterly ruined by an earthquake felt throughout Venezuela and as far as Carthagena (600 miles) The shock occurred shortly after 4 P.M As it was Ascension Day, large crowds had collected in the churches before the processions through the streets began, and three or four thousand persons were killed by the fall of the roofs Throughout Venezuela, more than 20,000 persons perished On April 24, the first eruption of the Soufrière of St Vincent since 1718 began The noise from it was heard at Caracas (nearly 400 miles)

Mar 27, 1606 Great Storm in Belgium.—At 8 A.M. began a great tempest of wind which continued

until 2 or 3 P M, and especially from 9 A M to 1 P M, during which time the great force of the storm threw down chimneys and very great trees, and unroofed almost all the churches and a great part of the houses It blew with such fury that one expected every minute to perish, and it surpassed the storm of Mar 27, 1524

Mar 28, 1916 Gale and Snowstorm in England – Great numbers of elm trees in the southern and midland counties were uprooted, railway traffic was dislocated in the midlands on the Midland, L N W R, and G W R lines in consequence of snowdrifts and wrecked telegraph wires The snowfall was general throughout England and Wales, and greatest in the hill districts, where many villages were isolated, and farms and sheep buried beneath gigantic drifts, in some cases 40 feet deep In the Black Mountains the snow was 10 feet deep

Societies and Academies

LONDON

Royal Society, Mar 13 — **V B Wigglesworth** A theory of tracheal respiration in insects The theory provides for the increased demands for oxygen which arise locally in active tissues If it be assumed that the terminal portions of the tracheal tubes are bounded by a semi permeable membrane then liquid will be drawn up the tubes by capillarity until further progress is checked by osmotic pressure of the tissue fluids During activity lactic acid will be produced, osmotic pressure will rise, liquid will be absorbed and air will extend down the tubes towards the active tissues The theory is supported by experiments on mosquito larvæ (see NATURE, Dec 28, 1929, p 986) Some observations are recorded on the effects of certain poisonous gases and of oil on the tracheal system — **H Raistrick** and others Studies in the biochemistry of the lower fungi A résumé of the main results of investigations presented in eighteen papers communicated to the Society

Geological Society, Feb 5 — **E J Garwood** The Tuedian Beds of northern Cumberland and Roxburghshire east of the Liddelwater The series consists of sandstones, mudstones, shales, and impure limestones laid down mainly under lagoon conditions An interesting feature is the important algal development in the middle of the series The beds are intermediate in character between the freshwater facies of the Tweed district and the more marine facies of Westmorland The succession is described under three districts Northern Cumberland (Bewcastle district), Roxburghshire (Newcastleton district), Western Northumberland (Rothbury) In northern Cumberland the structure is that of a denuded anticline having a general north north easterly trend This area may be divided into two districts separated by the 'central' fault The Bewcastle district in the east is taken as the type, and the succession has been determined there The algal episode enters first in the Bewcastle Beds, but the conditions were unfavourable, and it is not until the Main Algal Series is reached that algal growths become important as rockbuilders In Roxburghshire east of the Liddelwater, the algal series is again well developed In Northumberland, the chief feature of interest is the rich development of *Mitcheldeania* and *Ortonella* near the summit of the Cementstone Group, the latter genus being especially characteristic of the highest two limestones in the neighbourhood of Rothbury — **Sir Douglas Mawson** and **C T Madigan** Pre Ordovician Rocks of the McDonnell Ranges (Central Australia) This paper concerns the age and stratigraphical relations of a great series of quartzites, slates, and limestones forming the southern front of the McDonnell Ranges These beds, dipping at a steep angle off the older Pre Cambrian basement (Arunta Complex) of the Ranges, extend in an east and west direction with wonderful regularity for a length of at least 150 miles This great series of rocks lies stratigraphically between the undoubted Ordovician rocks (Larapintine formation) and the Arunta Pre Cambrian Complex They form a Pre Ordovician series, upon which rests unconformably the Larapintine Formation with its basal members formed of conglomerates and breccias Horizons rich in Cryptozoa and *Girvanella* like algal growths characterise the series

Institute of Metals, Mar 12 (Annual Meeting) — **T A Rickard** The early use of the metals The industrial history of mankind is divisible into two major epochs— a stone age and a metal age The melting of copper probably preceded its extraction from minerals by some centuries and the production of bronze or hardened copper was a later stage in metal culture The critical event in the industrial history of man was the first melting of metal out of stone, and this appears to have occurred about 3500 B C Metal articles fashioned at earlier periods were made from native gold, silver, or copper, or from meteoric iron — **D Stockdale** The composition of eutectics A very sensitive apparatus for the taking of cooling curves is described, and a new method for the determination of the liquids from such curves is given The eutectic systems examined were as follows aluminium copper, antimony silver, cadmium tin cadmium zinc, copper silver, and lead tin — **N P Allen** Experiments on the influence of gases on the soundness of copper ingots The unsoundness in commercial ingots is not due to hydrogen alone but to hydrogen and cuprous oxide together which react in the solidifying metal to evolve steam Those elements which, when added to copper, endow it with the ability to cast soundly, do so by reducing the cuprous oxide present Carbon monoxide, carbon dioxide, and nitrogen are inert, so far as the formation of blowholes is concerned — **W E Prytherch** Gases in copper and their removal Experiments on the effect of oxygen, hydrogen, and sulphur dioxide on the soundness of copper Dissolved gases may be partially removed by (1) Slow solidification followed by remelting of the copper, (2) passing an inert gas, such as nitrogen, into the molten metal, (3) melting *in vacuo* Experiments to determine whether oxygen would remove hydrogen showed that the rate of oxidation was so slow as to make the method unpractical — **E J Daniels** Unsoundness in bronze castings The effects of some pure gases on the soundness of bronze, and of casting in sand moulds of metal subjected to various melting treatments, are described Nitrogen, carbon dioxide, and carbon monoxide are neutral towards bronze Hydrogen is capable, at certain rates of solidification, of causing unsoundness which can be suppressed by treatment with neutral gases Improvement in density of sand castings can be obtained by melting in a pot furnace with a thin fuel bed and good draught Degasification with nitrogen deoxidisers, and pre solidification gave negative results so far as improvement in density is concerned, but pre solidification appears to increase the strength — **R Genders** Macrostructure of cast alloys Effect of turbulence due to gases When an alloy is cast in a mould prepared by a coating of volatile material, the macrostructure of the resulting ingot may be considerably modified by the turbulence resulting from the evolution of gases by the mould coating

DUBLIN

Royal Irish Academy, Feb 24—**Joseph Algar and Mary Boylan** Azo dyes derived from diaceto resorcinol The preparation of some azo derivatives of diacetoresorcinol and of dichalkones is described Diazonium salts couple readily with diacetoresorcinol in alkaline solution forming compounds with tinctorial properties The latter condense with aromatic aldehydes under the influence of alcoholic hydrochloric acid or piperidine with the production of dichalkones containing an azo group, for example, phenyl azo dianisylidene diacetoresorcinol All the compounds described function as dyestuffs and give yellow to brown shades on mordanted wool—**Joseph Algar and A V Flaegel** The action of Grignard reagents on phthalide By the carefully regulated addition of o methoxyphenyl magnesium bromide to phthalide and decomposition of the resulting addition compound, the substance produced is α hydroxy α (2-methoxyphenyl) β, β′ benzo α, α′-dihydrofurane (I), a compound which very readily loses water with the production of complex dehydration products Reduction of I with sodium amalgam gives 2 methylol 2′-methoxy diphenyl carbinol (II) The addition of phthalide to an excess of the above Grignard reagent gives 2 methylol 2′, 2″ dimethoxy triphenyl carbinol (III) Dehydration of III with hydrochloric acid gas gives α-di (o methoxyphenyl) β, β′ benzo α, α′ dihydrofurane (IV) The latter, in benzene solution, exhibits a beautiful blue fluorescence

PARIS

Academy of Sciences, Feb 10—**Serge Bernstein** The limitation of derivatives of polynomials—**Louis Roy** The propagation of waves on elastic surfaces with six parameters—**Bertrand Gambier** Configurations—**Paul Delens** The representations of circles—**N Lusin** The problem of J Hadamard on the uniformisation of ensembles—**L Kantorovitch and E Livenson** The δs functions of Hausdorff—**Henri Cartan** Functions of two complex variables and the encircled domains of Carathéodory—**Miloch Radoitchitch** The fundamental domains of meromorph functions—**Lucien Féraud** The extension to the case of any number of degrees of freedom of a property relative to Pfaffian systems—**N Cetajev** The reciprocal of Lagrange's theorem—**Jean Courrègelongue** The formation of eddying movements behind immersed solids—**G Mouret** The conditions of passage through a section of a permanent current (of fluid), open, uniform, or gradually varied—**Henri Mineur** The movement of the double stars under the action of the field of gravitation of the galaxy—**G Ribaud** The calculation of the temperature of flames and their proportion of atomic hydrogen A calculation of the influence of the dissociation of hydrogen into atomic hydrogen on the temperature of flame The cases of hydrogen and oxygen and acetylene and oxygen are considered—**E Darmois** The action of boric acid and borates on the rotatory power of tartaric acid Boric acid has no action on ethyl tartrate, but borax at 40° C has a clear action The author agrees with the views of Lowry as to the constitution of these complex compounds—**Mlle Stéphanie Maracineanu** Remarks on a note by MM Fabry and Dureuil entitled "On a supposed transformation of lead" Reply to criticism, maintaining the accuracy of the original results—**G Reboul** A method of activation of matter The activation of metals described in an earlier note by treatment with high voltages has been proved by further experiments to be independent of the nature of the metal and of the conditions of working, and the origin of the activity appears to be in the air—**A Astruc, M Mousseron, and Mlle N. Bouissou** A new method for the micro estimation of the calcium ion The method, which is applicable for the determination of quantities of calcium between 0 1 mgm and 1 5 mgm, is based on the precipitation of the metal as the tungstate, reduction of the latter by titanous chloride, followed by comparison of the colour produced with a known standard—**Lespieau and Bourguel** A new ethylenic erythrite The new erythrite is

$$CH_2(OH)\ CH(OH)\ CH=CH\ CH(OH)\ CH_2(OH)$$

and is obtained by the reduction of the corresponding acetylene compound with hydrogen in the presence of colloidal palladium—**Louis Glangeaud** The age of the strata containing Orbitolines at the north of the province of Algiers—**Henri Termier** The vertical extension of the genus *Spiriferina* in Morocco From the evidence adduced it is concluded that this genus persisted in Morocco for a much longer period than in the north east of Europe—**Raymond Furon** The presence of copper in the French western Sudan—**Guilliermond** The formation of zoosporangia and the germination of the spores in *Saprolegnia*, in cultures on nutritive media containing neutral red Neutral red is a colouring matter which is almost non-toxic and is of great value for the study of vacuoles—**M Bridel and C Charaux** Oroboside, a new glucoside hydrolysed by emulsin, extracted from *Orobus tuberosus*, and its products of hydrolysis, glucose and orobol The products of the hydrolysis of oroboside by emulsin are glucose and a substance, orobol, described in detail It appears to be a tetra hydroxyflavone further work is in progress with the view of determining its exact constitution—**H Lagatu and L Maume** Observation, by leaf diagnosis, of the phenomenon of mutual physiological replacement of two bases, lime and potash—**Lenglen and Durier** Appreciation of the value of powdered limestones used in agriculture The solubility of a limestone in a solution of carbon dioxide in water under fixed conditions depends largely on its physical structure as well as on its state of division The correlation between carbonic acid solubility and neutralising action on the soil has been proved—**Charles Pérez** Visceral asymmetry and dimorphism of the spermatophores in some pagurians—**Mlle Simone Mouchet** The comparative morphology of the excretory canals of some pagurians—**P Portier and Mlle de Rorthays** The mode of flight of insects and the wing load per unit of surface There is a striking concordance between the modes of flight of various insects and their anatomo physiological characteristics—**H Simonnet and G Tanret** The toxicity for laboratory animals of large doses of irradiated ergosterol The toxic action of irradiated ergosterol on rabbits was found to be associated with a calcification of the arterial system, but the venous system and the pulmonary artery remained free from calcification Owing to the varying toxic action on different animals, no conclusion can be drawn as to the action on human beings—**F Labrousse and Mlle S Philippon** Phenomena of oxido reduction observed in the course of the development of some fungi—**H Bierry** Proteid sugar and mannose in mammals

CRACOW

Polish Academy of Science and Letters, Dec 2—**K Kordylewski** The variable stars Orionis 47 1929 and 49 1929—**Mlle H Grünbaum** New resonance of selenium.—**P. Swings** The structure of the groups of resonance lines of sulphur vapour.—**L Marchlewski and A Boryniec** The absorption of ultra-violet radiations by the methoxybenzoic acids The absorption in the ultra violet by *p* methoxybenzoic acid

is much more intense (about six times) than that given by the meta isomer —K Dziewonski, J Auerbach, and J Moszew 1, 8-Benzyl benzoyl-naphthalene and some of its derivatives —M Thomaschewski The pollen analysis of the peat bogs of Sztengwald and of Zaskoczyn (Free Town of Dantzig) The results obtained are analogous with those found for southern Sweden —S Skowron Researches on spermatogenesis *in vitro* —A Wierzejski The fresh water sponges —T Marchlewski Genetic researches on the domestic dog

Official Publications Received

British

Empire Cotton Growing Corporation Reports received from Experiment Stations, 1928-1929 Pp. xi+268 (London) 2s 6d

Home Office Welfare Pamphlet No. 7 Lighting in Factories and Workshops. Third edition Pp. 25 (London H M Stationery Office) 4d net.

The Scientific Proceedings of the Royal Dublin Society Vol 19 (N S) No 29 Studies on Peat. Part 3 Low Temperature Carbonization of Peat By James T Donnelly and Joseph Reilly Pp. 365 376 1s Vol 19 (N S), No. 30 The Nitration of substituted Phenylbenzylamine Derivatives By J Reilly, T V Creedon and P J Drumm Pp 377 379 6d Vol 19 (N S), No 31 A Study of Two New Species of Bacteria belonging to the Genus Chromobacterium By Dr M Grimes Pp. 381 384. 6d (Dublin Hodges, Figgis and Co London Williams and Norgate Ltd)

City and County of Bristol The Bristol Museum and Art Gallery Report of the Museum and Art Gallery Committee for the Year ending 30th September 1929 Pp 24+4 plates (Bristol)

National Joint Industrial Council for the Flour Milling Industry Technical Education Series, Pamphlet No 5 Pests in Wheat and its Products By Sebert Humphries Pp 36 (London) 6d net

The Imperial College of Tropical Agriculture Prospectus for 1930-31 also Principal's Report for 1928-29 and Register Pp. 47+8 plates (St. Augustine, Trinidad London)

The Carnegie Trust for the Universities of Scotland Twenty eighth Annual Report (for the Year 1928-29) submitted by the Executive Committee to the Trustees on 12th February 1930 Pp. iv+78 (Dunfermline)

John Murray 50 Albemarle Street, 1768-1930 Pp. 14 (London)

Journal of the Indian Institute of Science Vol 12A, Part 17 i Contributions to the Study of Spike Disease of Sandal (*Santalum album*, Linn) Part 7 Factors influencing Diastatic Activity by B N Sastri and M Sreenivasaya, ii Part 8 Chemical Composition of Tissue Fluids from the Leaf by M Sreenivasaya and B N Sastri iii Part 9 Chemical Composition of Tissue Fluids from the Stem by M Sreenivasaya and B N Sastri iv Note on the Starch Liquefying Action of Sandal Leaf Extracts, by B N Sastri Pp 233 252 1 4 rupees Vol 12A, Part 18 Studies on Soil *Actinomyces* Part 3 Standardisation of a Plate Method of counting Soil *Actinomyces* By M Ganesho Rao and V Subrahmanyan Pp 253 278 1 4 rupees Vol 12A, Part 19 i Biological Oxidation of Sulphur Part 2 Effect on the Microflora of Activated Sludge By C V Ramaswami Ayyar and Roland V Norris Pp. 275 294 1 4 rupees Vol. 12A, Part 20 Contributions to the Study of Spike Disease of Sandal (*Santalum album*, Linn) Part 10 Seasonal Studies on Healthy and partially Spiked Trees By A V Varadaraja Iyengar Pp 295 305 12 annas. (Bangalore)

Melbourne Astrographic Catalogue, 1900-0 Vol 3 Zones -69 and -70° Rectangular Co ordinates and Diameters of Star Images from Photographs taken and measured under the direction of R L J Ellery and Pietro Baracchi Revised and prepared for publication under the supervision of Dr J M Baldwin. Pp xl+254 (Melbourne H J Green)

The Journal of the Institution of Electrical Engineers Edited by P F Rowell. Vol. 68, No 398, February Pp. 205 310+xxxvi (London E and F N Spon, Ltd) 10s. 6d

The Indian Forest Records Vol 14, Part 4 Immature Stages of Indian Coleoptera (6). By J C M Gardner Pp. 30+6 plates (Calcutta Government of India Central Publication Branch) 1 2 rupees 2s

Journal of the Society of Glass Technology Edited by Prof W E S Turner Vol. 13, No 52, December 1929 Pp xli+79 430+x+xxviii (Sheffield) 10s. 6d

Far Eastern Association of Tropical Medicine Transactions of the Seventh Congress held in British India, December 1927 Edited by Lieut Col J Cunningham Vol 3 Pp xv+761+38 plates (Calcutta Thacker's Press and Directories, Ltd)

Foreign

U S. Department of Agriculture Technical Bulletin No 170 A Pipette Method of Mechanical Analysis of Soils based on Improved Dispersion Procedure By L B Olmstead, Lyle T Alexander and H E Middleton. Pp. 23 (Washington, D C. Government Printing Office) 5 cents.

Smithsonian Miscellaneous Collections Vol 82, No. 2 The Thoracic Mechanism of a Grasshopper, and its Antecedents. By R. E Snodgrass (Publication 3027) Pp. 111 (Washington, D C Smithsonian Institution.)

Field Museum of Natural History Geology Leaflet 11 Neanderthal (Mousterian) Man By Oliver C Farrington and Henry Field Pp. 14+9 plates. 25 cents. Geology Leaflet 12 Cement. By Henry W Nichols Pp. 15+4 plates 25 cents Anthropology Leaflet 28 The Field Museum Oxford University Expedition to Kish, Mesopotamia, 1923-1929 By Henry Field. Pp. 24+14 plates. 50 cents (Chicago.)

Conseil Permanent International pour l'Exploration de la Mer Rapports et procès verbaux des réunions Vol 64 Current Measurements, Direct and Indirect Reports of the Proceedings of a Special Meeting held on April 13th, 1929, in London. Pp. 77 3 75 kr Vol 65 Fluctuations in the Abundance of the various Year Classes of Food Fishes, Reports of the Proceedings of a Special Meeting held on April 12th, 1929, in London. Pp. 188 7 25 kr (Copenhague Andr Fred Høst et fils)

Agricultural Experiment Station, Michigan State College of Agriculture and Applied Science Circular Bulletin No 127 Pruning Young Fruit Trees By Roy E Marshall, H A Cardinell and H D Hootman Pp 32 Circular Bulletin No. 128 Undulant Fever in Man and Abortion Disease in Cattle some Facts that the Consumer and Producer of Milk and the Breeder of Cattle should Know By E T Hallman and E I Anthony Pp 4 (East Lansing, Mich.)

Scientific Papers of the Institute of Physical and Chemical Research No 230 Researches on the Cutting Force Report 1 New Designs of Tool Dynamometer By Makoto Okoshi Pp 167 192 Tokyō Iwanami Shoten) 40 sen

Field Museum of Natural History Publication 258 i Supplement to the Flora of Barro Colorado Island Panama, by Leslie A Kenoyer and Paul C Standley ii Two new Species of Chara from Tropical America, by M A Howe (Botanical Series, Vol 4, No 6) Pp 141 161+plates 11 18 Publication 259 Spermatophytes, mostly Peruvian By J Francis Macbride (Botanical Series Vol 4, No 7) Pp 163 193 Publication 260 The Mineral Composition of some Sands from Quebec, Labrador and Greenland By James H C Martens (Results of the Rawson Macmillan Sub Arctic Expedition of 1926) (Geological Series, Vol 5 No 2) Pp 15 31+plates 7 9 Publication 261 A New Rodent from the Galapagos Islands By Wilfred H Osgood (Zoological Series, Vol 17, No 2) Pp 19-24 Publication 262 Contents and Index to Volume 12 Numbers 1 to 19 (Zoological Series Vol 12 No 19) Pp ix+508 526 Publication 263 Birds of the James Simpson Roosevelts Asiatic Expedition By Charles E Hellmayr (Zoological Series Vol 17 No 3) Pp 25 144 Publication 264 Studies of American Plants-I, by Paul C Standley Studies of American Plants-II, by Paul C Standley (Botanical Series, Vol 4 No 8) Pp 195 345 Publication 265 The Land Mammals of Uruguay By Colin Campbell Sanborn (Zoological Series Vol 17 No 4) Pp 145-165 Publication 266 Catalogue of Birds of the Americas and the Adjacent Islands in Field Museum of Natural History including all Species and Subspecies known to occur in Northern America, Mexico Central America South America the West Indies and Islands of the Caribbean Sea, the Galapagos Archipelago and other Islands which may be included on account of their Faunal Affinities By Charles E Hellmayr Part 6 Oxyruncidae Pipridae Cotingidae, Rupicolidae, Phytotomidae (Zoological Series, Vol 13) Pp v+258 Publication 267 Honduran Mosses collected by Paul C Standley By Edwin B. Bartram (Botanical Series Vol 4 No 9) Pp 347 364+plates 17 19 (Chicago)

Smithsonian Miscellaneous Collections Vol 82 No 4 The Characters of the Genus *Geocapromys* Chapman By Gerrit S Miller Jr (Publication 3029) Pp. 3+1 plate Vol 82, No 5 Mammals eaten by Indians Owls and Spaniards in the Coast Region of the Dominican Republic By Gerrit S Miller Jr (Publication 3030) Pp 16+2 plates (Washington, D C Smithsonian Institution)

Catalogues

A Catalogue of Miscellaneous Books (No 449) Pp 40 (Cambridge Bowes and Bowes)

S U P 36 in the Treatment of Influenza Pp 8 (London The British Drug Houses, Ltd)

Diary of Societies

FRIDAY, MARCH 21

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botany Lecture Room, Imperial College of Science and Technology), at 2 30 —The Nutrition of Fruit Trees —T Wallace Some Effects of Deficiencies of Essential Elements on Fruit Trees —R G Hatton Response of Apple Trees on known Rootstocks to Applications of a Complete Fertiliser —N H Grubb The Reaction to Potash Fertilisers of Apple Trees in the Field —Dr T Swarbrick Some Observations upon the Growth and Seasonal Cycle of Food Reserves in Apple Trees

DIESEL ENGINE USERS ASSOCIATION (at Caxton Hall), at 3 30 —H R. Ricardo The High Speed Diesel Engine

IMPERIAL COLLEGE CHEMICAL SOCIETY (at Royal College of Science), at 5 —Prof I M Heilbron The Fat Soluble Vitamins A and D (Lecture).

LONDON SOCIETY (at Royal Society of Arts), at 5.—Dr R. Unwin The Decentralisation of Industry

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section) at 5 —Dr C W Buckley and others Discussion on The Influence of Sunlight and other Climatic Factors in Health and Rheumatic Diseases

BRITISH INSTITUTE OF RADIOLOGY (Medical Section), at 5 —Discussion on Radiology in Chest Diseases

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Sir Frank Colyer Demonstration of Specimens Illustrating Dento alveolar Abscess and Dental Cyst

INSTITUTION OF MECHANICAL ENGINEERS, at 6 —W Nithsdale The Design and Results of a 660 lb per sq in Boiler Installation

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle upon Tyne), at 6 —Sir Westcott Abell Direct Flooding Calculations

INSTITUTE OF MARINE ENGINEERS, at 6 30.—Annual General Meeting

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at St. Thomas Café, Swansea), at 7 —Annual General Meeting

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at 36 George Street, Manchester), at 7 —A. J Hall The Effect of Swelling Agents on the Creasing of Artificial Silks —J R. Hannay The Preparation of Artificial Silk and Cotton Unions for Printing.—Eva Hibbert On the Action of Certain Acids on Cellulose —J H Preston The Mounting of Textile Fibre Sections.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section) (Informal Meeting), at 7.—A. J. Gibbons and others: To Meter or not to Meter.—W. Lawson and others: Whether or not Meters should be Stamped and Sealed.—E. Fawssett and others: The Use of 1 amp. Secondaries in Current Transformers as against 5 amp. Secondaries.—C. H. Green and others: Whether or not Prepayment Meters should be Earthed.—G. F. Shotter and others: Formula for the Merit factor of a Meter.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7.

INSTITUTION OF ELECTRICAL ENGINEERS (North Eastern Students' Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.15.—J. Bennett and O. A. Chrisp: A Survey of Switch and Control Arrangements with Examples of Modern Practice.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—M. V. Hurst: Surface Combustion.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section), at 8.—Dr. J. E. Hughes: A Case of Hydatidiform Mole with Multiple Synoytial Infarction of the Lungs.—Dr. A. F. Gyles: The Influence of Hysteropexy on Subsequent Pregnancy, and of Pregnancy on a Previous Hysteropexy.—Prof. W. F. Shaw: The Treatment of Prolapsus Uteri.

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—Dr. J. M. W. Morison: Diaphragmatic Hernia.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Seton Gordon: Sea Birds and Seals.

PAPER MAKERS' ASSOCIATION (Technical Section, Northern Division) (at Engineers' Club, Manchester).—N. L. Matthews: The Application of Dyestuffs to Paper.

SATURDAY, MARCH 22.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Yorkshire District) (jointly with North Western District) (at Town Hall, Halifax), at 2.15.—F. Marsden: Borough and County Borough Extensions in the Light of the Local Government Act, 1929.

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College), at 3.—C. L. Beaven and others: Discussion: Are we satisfied with the Present Syllabus in Mathematics for the General School Certificate?

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: Atomic Nuclei and their Structure.

MONDAY, MARCH 24.

KING'S COLLEGE ENGINEERING SOCIETY (Anniversary Meeting), at 5.30.—Brig.-Gen. M. Mowat: A Brief Review of Mechanical Engineering Progress in the Past Thirty-four Years.

BRITISH PSYCHOLOGICAL SOCIETY (Joint Meeting of Industrial and Education Sections) (at National Institute of Industrial Psychology), at 6.—The Relation of Raising the School Leaving Age to Problems of Vocational Guidance and Selection.—Miss Sheila Bevington (from point of view of Vocational Guidance), F. Tibbey (from point of view of Education).

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (Annual General Meeting) (at Great Northern Station Hotel, Leeds), at 7.—Dr. N. K. Adam and others: Discussion on The Fundamentals of Lubrication.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7.

INSTITUTION OF ELECTRICAL ENGINEERS (North Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—H. A. Humphrey, D. M. Buist, and J. W. Bansall: The Imperial Chemical Industries Limited's Steam and Electric Power Plant at Billingham.

ROYAL SOCIETY OF ARTS, at 8.—Comdr. F. G. Cooper: Aids to Navigation (Cantor Lecture) (1).

MEDICAL SOCIETY OF LONDON, at 8.—Sir Thomas Horder, K. Walker, and others: Discussion on Coliform Infections of the Genito-urinary Tract.

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—Sir William Willcox: Dental Sepsis—a Retrospect.—F. Coleman: Buried Mandibular Teeth with Crowns in Occlusion.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Dr. E. Trinkler: Exploration in the Karakoram and Kun Lun.

TUESDAY, MARCH 25.

ROYAL SOCIETY OF ARTS (Dominions and Colonies Meeting), at 4.30.—O. J. R. Howarth: The Work of the British Association in Relation to the Empire.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. C. F. Coombs: Syphilis of the Heart and Great Vessels (Lumleian Lectures) (2).

ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5.—Prof. E. Leschke, Dr. J. Parkinson, Dr. J. Cowan, Dr. T. F. Cotton, and others: Discussion on Syphilitic Aortitis.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. C. Singer: The Passage from Mediæval to Modern Science (3): On the Inductive Philosophy and some of its Instruments.

INSTITUTION OF CIVIL ENGINEERS, at 6.—D. Anderson: Tyne Bridge, Newcastle.—G. I. Groves: The New Wearmouth Bridge, Sunderland.

BRITISH PSYCHOLOGICAL SOCIETY (Industrial Section) (jointly with Education Section), at 6.—Discussion on Vocational Guidance and Selection in Relation to the Raising of the School-leaving Age, with papers dealing with the question from the point of view of (*a*) Education, (*b*) Vocational Guidance and Selection, (*c*) Industry.

ROYAL AERONAUTICAL SOCIETY (at 7 Albemarle Street), at 6.30.—Annual General Meeting.

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at Loughborough College), at 6.45.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—H. A. Humphrey, D. M. Buist, and J. W. Bansall: The Imperial Chemical Industries Limited's Steam and Electric Power Plant at Billingham.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—W. Clark: The Characteristics of Sound Recording Emulsions.—W. Clough: The Pantone Process of Reproduction.

ILLUMINATING ENGINEERING SOCIETY (at Home Office Industrial Museum, Horseferry Road, S.W.1), at 7.—S. Anderson: Textile Lighting.

SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield), at 7.30.—F. W. Rowe: Common Defects in Steel for Gear Manufacture.

WEDNESDAY, MARCH 26.

CHEMICAL SOCIETY (at Salters' Hall, E.C.), at 5.30.—Prof. G. von Hevesy: The Chemistry and Geochemistry of the Titanium Group (Hugo Muller Lecture).

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—W. Campbell Smith: A Classification of some Rhyolites, Trachytes, and Phonolites from Part of Kenya Colony, with a Note on some Associated Basaltic Rocks.—Dr. T. N. George: *Ambocœlia* Hall and certain similar British Spiriferidæ.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at 17 Fleet Street), at 5.30.—A. Titley: Winding Engines of Richard Trevithick.

INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.30.—P. J. Pollock: Nomography as Applied to Engineering.

INSTITUTION OF AUTOMOBILE ENGINEERS (Manchester Centre) (at Engineers' Club, Manchester), at 7.—Capt. J. S. Irving: Problems Encountered in the Design of the *Golden Arrow*.

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.—E. G. Lowes: The Development of Auxiliary Machinery as applied to Ships.

HALIFAX TEXTILE SOCIETY (at Halifax), at 7.30.—Discussion on Education.

ROYAL SOCIETY OF ARTS, at 8.—H. Robertson: Architecture of To-day and To-morrow.

EUGENICS SOCIETY (at Royal Society), at 8.30.—Dr. J. A. Ryle: Constitution as a Factor in Morbidity.

THURSDAY, MARCH 27.

CHEMICAL SOCIETY (Annual General Meeting), at 4.—Prof. J. F. Thorpe: Presidential Address.

ROYAL SOCIETY, at 4.30.—Discussion on Geological Climates opened by Dr. G. C. Simpson, followed by Prof. A. C. Seward, Prof. J. W. Gregory, Sir Peter Mitchell, C. E. P. Brooks, and Dr. C. Tate Regan.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. C. F. Coombs: Syphilis of the Heart and Great Vessels (Lumleian Lectures) (3).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—J. B. S. Haldane: Some Problems of Genetics.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—H. H. Harrison: Developments in Machine Telegraph Systems and Methods of Operation.

BATLEY AND DISTRICT TEXTILE SOCIETY (Annual General Meeting) (at Batley Technical College), at 7.30.—H. R. Hirst: Faults in Yarns and Cloths, their Detection and Prevention.

MEDICO-LEGAL SOCIETY (at 11 Chandos Street, W.1), at 8.30.—Prof. J. S. Haldane: Carbon Monoxide Poisoning and its Medico-Legal Aspects.

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch).—Aircraft Accessories.

INSTITUTE OF RUBBER TECHNOLOGISTS (at Manchester Café, Ltd., Manchester).—H. Riding: Some Notes on Ebonite.

FRIDAY, MARCH 28.

ROYAL SOCIETY FOR THE PROTECTION OF BIRDS (at Middlesex Guildhall, Westminster), at 3.—Annual Meeting.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section) (at King's College Hospital), at 4.30.—Clinical Meeting.

PHYSICAL SOCIETY (Annual General Meeting) (at Imperial College of Science), at 5.—Presentation of the Duddell Medal to Prof. A. A. Michelson.—At 5.45 (at City and Guilds Engineering College).—Exhibition of Research Work now in Progress.

INSTITUTION OF ELECTRICAL ENGINEERS (North Western Centre jointly with Manchester Association of Engineers) (at Manchester), at 7.15.—J. Calderwood: Marine Diesel Installations with particular reference to Auxiliary Machinery.

JUNIOR INSTITUTION OF ENGINEERS (at Royal Society of Arts), at 7.30.—G. S. Taylor: Industrial Accidents: their Cause and Prevention (Gustave Canet Memorial Lecture).

ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8.—Dr. W. Fletcher: Typhus-like Diseases of Unknown Etiology.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir Ernest Rutherford: The Transmutation of Matter.

INSTITUTION OF ELECTRICAL ENGINEERS (West Wales (Swansea) Sub-Centre).

SATURDAY, MARCH 29.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: Atomic Nuclei and their Structure (4).

PUBLIC LECTURES.

SATURDAY, MARCH 22.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—M. A. Phillips: Pond Life.

SATURDAY, MARCH 29.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—I. E. Dallas: June Flowers in Alpine France.

Editorial and Publishing Offices

MACMILLAN & CO., LTD.

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SATURDAY, MARCH 29, 1930.

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No 3152, Vol 125]

Psychology and Industry

DURING the last fifty years there has developed a much closer association between scientific research and productive industry than was formerly the case, as is well known, many firms now have excellently equipped laboratories, staffed by highly qualified scientific men and technicians, devoting the whole of their time to devising improvements in the means of production and in the commodity produced These activities, however, are concerned primarily with the technical and mechanical aspects, hitherto much less attention has been paid to the human factor in industry and commerce It is very encouraging, therefore, to learn from the ninth annual report [1] of the National Institute of Industrial Psychology, just issued, that large employers of labour are now recognising to an ever increasing extent the value of the study of human 'behaviour' and 'endeavour', in relation to manufacturing processes and business organisation—that is, the application of psychology in the factory, workshop, and office

This appreciation is by no means confined to the employers who benefit by increased production The workpeople in the various establishments in which the Institute has conducted investigations have invariably extended their whole hearted co-operation in the experimental work, and acknowledged the variety of advantages—lessening of strain, irritation, worry and boredom, and increase of earnings, etc —derived from the adoption of the suggestions put forward by the industrial psychologist

Merely to state that the purpose of the Institute is the application of the principles of psychology and physiology in industry and commerce, is to indicate at once the variety of problems with which it is concerned and the wide field to be covered Members of the Institute's staff have been engaged in investigating the best methods of applying human energy in factories, offices, etc, especially in regard to the elimination of unnecessary movements, the most advantageous distribution of periods of rest and work, and the determination and realisation of other conditions which tend to the maximal health, comfort, and well-being of the worker They have also been concerned in the planning of the lay-out of plant, the co-ordination of processes in production, and the reduction of monotony There has been considerable develop-

[1] Obtainable from the Secretary to the Institute, Aldwych House, London, W C 2

ment in the application of suitable methods so as to secure more efficient and scientific selection of workers and enabling trustworthy guidance to be given to adolescents when choosing their life's work The educational activities of the Institute include the provision of training courses for managers, foremen, investigators, etc, lectures for employers and workers, and the publication of the facts established by its research work

The research work undertaken by the Institute, mainly by grants from the Rockefeller Trust, forms an important complement to the valuable researches carried out by the corresponding Government body, the Industrial Health Research Board, which is under the direction of the Medical Research Council The Institute's investigations in the field are of course largely dependent on the knowledge derived from such research

Industrial processes are so numerous, the conditions which obtain in factories, workshops, and commercial undertakings differ so much, and the types of workpeople and staffs are so varied, that only actual investigation in the establishments themselves can be expected to provide solutions to the many difficulties confronting the employers and the workers engaged in them The best evidence of the value of these investigations is that firms which have engaged the Institute's services have given 'repeat orders' for the extension of the work to other departments of their businesses Again, these investigations have been carried on in all kinds of industries, differing largely in their methods of organisation for production and distribution, but in all cases it has been possible, after a close examination of the situation by an expert in industrial psychology, to effect improvements in the conditions under which the operatives work or in the manufacturing processes and, generally, in both directions concurrently

In the safety razor blade department of a cutlery factory, the Institute's investigator recommended the installation of various mechanical devices to limit non-productive time (which in certain processes occupied as much as 53 per cent of the working period) and to minimise waste In 'piercing' alone, it was calculated that an annual saving of £200 would be effected on £2000 worth of material The improved organisation in the polishing and stropping shops led to increases in output of 78 per cent and 23 per cent respectively Rest pauses were introduced in the grinding shop with good results, and movement studies led to the devising of better working methods of grinding and polishing Also, suggestions were made for a new method of payment by progressive piece rates which would provide a more effective incentive to increased output

Among many other investigations carried out during the year, the report mentions a spinning mill in which such varied subjects as illumination, analysis of sales and organising production with the view of reducing costs of manufacture, and planning of work ahead were considered, a fancy goods factory where an annual saving of £1400 will be effected by the reorganisation of the gangs working the presses, and a railway service for which the lay-out of the iron foundry in the locomotive works was re planned, including the mechanisation of certain heavy operations resulting in the expenditure of less physical energy on the part of the workmen The report also gives interesting details of investigations into such varied businesses as a gas works, a chemical works, a number of radio manufactures, telephone and cable factories, textile machinery, a departmental store, engineering works, offices, and the General Post Office In all such investigations it not infrequently happens that the psychologist discovers factors which, although individually of apparently minor importance, have a cumulative detrimental effect upon the workers, with a consequential effect upon the nature and the amount of work performed

The need for assistance to a boy or girl in the choice of a career on leaving school is becoming more and more recognised, and in its vocational guidance and selection departments the Institute has conducted a large amount of research work and shown the definite value of psychological tests In 1922 it carried out a joint experiment with the Industrial Health Research Board In 1924 it began an experiment on a larger scale in the course of which the careers of 1200 London boys and girls have been closely examined Psychological tests were applied to 600, upon the results of which they were advised in the choice of an occupation, while the other 600 (regarded as a 'control' group) received the advice normally given by one of the Juvenile Advisory Committees of the Ministry of Labour

This experiment has been made possible by grants from the Carnegie United Kingdom Trusts, by the co-operation of the London County Council in enabling the tests to be carried out during the pupil's last term at school, and by the Ministry of Labour in the finding of suitable employment for the boys and girls after leaving school The completed results of this experiment are likely to

be published during this year, but the information already received indicates clearly that psychological examination with advice based upon scientific research must have in future a definite place in our system of vocational guidance and selection Other experiments of this nature with which the Institute is closely concerned are being conducted in conjunction with the Birmingham Education Committee and with the Fife Education Authority

This branch of the Institute's activity is not confined to school leavers Similar work has been successfully accomplished in connexion with higher administrative posts in businesses and in the selection of overseers, foremen, etc , in manufacturing establishments As a consequence of the introduction of these methods in a textile mill, the *total* labour turnover *due to dismissals* has fallen from 9 5 to 6 2 per cent since the adoption of the Institute's recommendations A large engineering firm reports that it has definitely proved that "the test gives us within an hour the measure of the boy's suitability which it would take three to six months to obtain in the works under the control of a foreman"

The Institute, of which the late Earl of Balfour was president until his death, is to be congratulated upon a very successful year of work—work of national importance which affects the community in a variety of ways, all tending towards the improvement of the conditions in which we work and live Its aim, like that of a hospital medical school, is to combine practice, training, and research The cost of the factory investigations of the Institute is met by the fees paid by the employers, but large numbers of applicants for vocational guidance must be turned away owing to their inability to pay for its expense Not only the vocational guidance work, but also the training and research sections of the Institute need endowment Indeed, as the Prime Minister recently said at the annual dinner of the Institute, "If you were endowed with something like a million a year, you could spend it in such a way that not a farthing of your endowment would be wasted" The Institute now possesses laboratories, research rooms, a library, and a lecture room It is performing services of unique national importance, welcomed by all classes of the nation It is appealing for an endowment fund of £100,000 in order to set its work on a permanent footing, and we cordially commend the appeal to trusts and generous benefactors desirous of promoting close contacts between the material and human factors of progressive life.

The Beginnings of Entomology.

Materialien zur Geschichte der Entomologie bis Linné Von Dr F S Bodenheimer Band 2 Pp vi + 486 + 4 Tafeln (Berlin W Junk, 1929) 2 vols , 100*s*

THE issue of the second volume of this important work has speedily followed the publication of the first (reviewed in NATURE for June 22, 1929) The present instalment, as exact and thorough in its treatment as its predecessor, gives evidence of immense industry on the part of the author, Dr F S Bodenheimer Continuing the subject of the study of insects during the seventeenth and eighteenth centuries, the volume before us opens with a section on applied or economic entomology, with especial reference to agriculture, sericulture, and bee keeping

The treatises on these departments that appeared from 1600 onwards were both numerous and bulky Besides precepts of some practical benefit, they were apt to contain a large quantity of valueless matter Much attention, however, was paid to the protection of orchard and garden produce from the ravages of caterpillars The migrations and depredations of locusts, more important to European husbandry in former days than at present, are noticed by the author at some length , much recent literature on the subject is quoted, and the recent researches of Uvarov are referred to with approval Interesting chronological tables are given of the occurrence of locust swarms in various countries of Europe Under the head of noxious insects, the author takes occasion to commend the remarkable observations of the Englishman, Robert Southall, recorded in his "Treatise on Buggs" (1730), and to regret that his remedial measures have not met with more recognition

An important section of the work is devoted to the subject of learned societies and academies To the influence of these institutions the author rightly attributes the wide diffusion of the spirit of inquiry which took its rise about the middle of the seventeenth century As those most deserving the attention of entomologists he enumerates the Royal Society of London, the Academy of Schweinfurth in Franconia, and the Paris Academy of Sciences The first named of these societies is, as the author truly declares, of more importance in the history of entomology than any of the continental associations But here, for once, we catch Dr Bodenheimer tripping Perhaps even an English reader might fail to recognise under the style of "Christophus Wien" the architect

of St Paul's Cathedral The misnomer is repeated on the same page, also in the index, and is accompanied by other orthographical curiosities of less importance Moreover, in the list that he gives of histories of the Royal Society, we look in vain for the monumental work of Bishop Sprat

Dr Bodenheimer does full justice, however, to the admirable performance of the Royal Society in realising and promoting from the outset the international character of natural science, a task in which it continued to lead the way for at least the first hundred years of its existence The *Philosophical Transactions* included from their first issue in 1665 entomological communications of considerable importance The first volume contains notices of silk and cochineal culture, as well as of insect plagues in America and the Ukraine On these speedily followed in later volumes the hitherto neglected work of Edmund King on the natural history and development of ants, physiological experiments on insects by Robert Boyle, Willughby's observations on the leaf cutter bee, and, what is perhaps especially noticeable, a list of 'inquiries and directions' for the guidance in entomological research of residents in foreign countries Much space is given by the author to the record of the early years of this Society, the efforts of which towards international co operation in the cause of science merit and receive his warm approbation

Excellent work from 1652 onward was produced by the members of the Schweinfurth Academy Among these were Muralto, Mentzel, Heister, and Loeber, whose researches dealt with the anatomy and life history of the mole cricket, dragon fly, breeze fly, and locust respectively A better-known name is that of Vallisnieri, who published in 1715 an illustrated account of the praying mantis with its portable egg packet

A remarkable item in the memoirs of the Paris Academy of Sciences is the first attempt at a natural classification of the Lepidoptera, based not only on the perfect insect, but also on the immature stages This was the work of Guettard, and dates from 1749

On the advent of journeys of exploration, there naturally followed an increasing knowledge of the forms of insect life The interest excited in this department tended rather, as in an earlier period of inquiry, to centre in the utilitarian aspect of the subject, in such insects, for example, as were serviceable in providing material for drugs or dyes, or, on the other hand, were capable of inflicting annoyance or damage, such as the dreaded 'jigger'

A genuine scientific spirit was shown by Marcgrave, who accumulated a large stock of entomological and other zoological observations in Brazil, unhappily, he died in 1644 at an early age At a later period, good natural history work was done in the West Indies by our countrymen Sir Hans Sloane, Griffith Hughes, and Patrick Browne, all of whom devoted a great part of their attention to entomology

In North America, also, the last half of the seventeenth and first of the eighteenth century produced many good observations on the insect fauna of that continent It is interesting to note that several of these saw the light under the auspices of the Royal Society, which association was, as we have seen, indefatigable in encouraging the researches of its correspondents, whether native or foreign, in all parts of the world In the eastern hemisphere, the same period was marked by the work of Hasselquist in Egypt, Syria, and Asia Minor, and of Adanson in Senegal, with a large number of other observant travellers In connexion with the new interest in geographical distribution, the subject of the dissemination of noxious insects attracted attention, and their introduction into European countries by human agency was dealt with by Osbeck, Kalm, and Bartholini On the gradual elucidation of the history of the cochineal and lac insects the author has much to say, the economic value of their products appealed strongly to the commercial spirit of the time

Curious evidence of the superstitious dread awakened by unusual and unexplained occurrences is afforded by the consternation that followed the supposed descent of insects in snow (Hungary, 1672), and the sudden appearance of swarms of a wood boring wasp (Prussia and Poland, 1679) The adaptation of insects to the changes of season, and the instincts that lead them to provide for their young, were dealt with, much on the lines afterwards developed by Paley, by William Derham, author of "Physico Theology", known also for his study on the death watch beetle, communicated to the Royal Society

A long list of popular works on entomology which appeared during the eighteenth century gives proof, says the author, that the foundation had been well laid for the great increase of interest in the study of insects which marks the following period Similar testimony is afforded by the formation of entomological collections, which, first started by Aldrovandi and Gesner early in the

seventeenth century, were continued on a large scale in the form both of private collections and public museums Among the latter a conspicuous place was taken by the British Museum, which soon after its foundation in 1753 acquired the extensive entomological collection of Petiver A photograph is given by the author of some of Petiver's Lepidoptera which are still preserved in the national collection Linnæus's own collection was acquired after his death by the Society which bears his name in London Both Oxford and Cambridge possessed large insect collections about the year 1750 In comparison with England, neither France nor Germany showed at this period much zeal in the formation of collections, Italy, however, established several museums in which entomology was to some extent represented

With the publication in 1758 of the tenth edition of his "Systema Naturæ", Linnæus may be truly said to have laid a secure foundation for systematic entomology The first edition (1735) made a fourfold division of insects into Coleoptera, Angioptera, Hemiptera, and Aptera By 1748, the date of the sixth edition, this division had been amplified, and in the tenth edition we find seven orders for the most part equivalent to those at present recognised The principal differences are that Linnæus's Coleoptera include the Orthoptera and Dermaptera, his Hemiptera include thrips, his Neuroptera have now been divided into five or more separate groups, his Aptera are also plainly heterogeneous The genera ranked by Linnæus under his orders correspond fairly closely with present day families But the greatest achievement of this tenth edition must be allowed to be the establishment of the binary system of nomenclature, which for the first time made exact identification possible

With a full, but not unduly copious estimate of the entomological work of Linnæus, Dr Bodenheimer brings the historical part of his book to a close There remains a carefully compiled series of tables in which is attempted an identification of all the species of insects mentioned by pre-Linnæan authors, from the Chinese writers onwards—a laborious task which few men, even with skilled assistance, would have had the courage to undertake But painstaking thoroughness is the mark of Dr Bodenheimer's enterprise from start to finish, and he has produced a work the value of which will be widely appreciated by all those whose tastes or avocations lead them to seek full and accurate information on the history of entomology

F A D

Our Nearest Living Relatives

The Great Apes a Study of Anthropoid Life By Prof Robert M Yerkes and Ada W Yerkes (Published on the Louis Stern Memorial Fund) Pp xix + 652 (New Haven Yale University Press, London Oxford University Press, 1929) 45s net

THIS stately book by Prof and Mrs Yerkes is an invaluable contribution to the study of the higher apes—gibbon, orang-utan, chimpanzee, and gorilla—and the historical part is so well done that it should never require elaboration The account of personal observations on chimpanzee and gorilla is not less valuable, but it will, of course, be added to and possibly modified by the authors and others In both functions of the book, the historical and the original, we recognise the critical acumen of the trained psychobiologist In the historical sections there is a rigorous and much-needed separation of the wheat from the chaff, the record of personal observations is a model of sceptical carefulness

We would say in general that this large and beautifully illustrated treatise is indispensable to those who would follow a line of investigation that has been characteristic of the last twenty years, the experimental and observational study of the higher apes It may be noticed that the gibbon and the siamang stand so much apart from the others, that Prof Yerkes would have omitted them altogether, which would have been a loss, had he been beginning his task afresh

The book begins with a general historical introduction, telling of man's ancient knowledge of the anthropoid apes, its extension during the Middle Ages, and its gradual improvement during the seventeenth and eighteenth centuries Thereafter a special part of the book is devoted to each of the four great types, and the method followed in each case may be indicated (1) structural peculiarities, species, and habitat, (2) mode of life in natural conditions, (3) life in captivity, (4) affective behaviour—for example, expression of emotions, words, temperament, (4) nervous system, sense organs, and receptivity in general, and (5) perceptual processes and intelligence The book ends with a comparative survey of the types and with a statement of conclusions The whole survey is characterised by lucidity, vivacity, and a mood of active scepticism In our judgment, the authors have steered their craft with shrewdness and courage between the Scylla of behaviourism and the Charybdis of anthropomorphism

Very interesting is the careful comparison between the four anthropoid types as regards external characters, habits, life-history, sociality, emotionality and expressivity, vocalisation (which never rises to language in the strict sense) and sensory receptivity The interest heightens when the authors come to the intelligence of apes, which they have no hesitation in rating high They compare the four types with one another, with monkeys, and with man as regards curiosity, imitation, parental instruction, attention, adaptivity, memory, imagination, instrumentation, and effective adaptation of environment The general result is to show that the orang utan, chimpanzee, and gorilla are mentally further from the monkeys and nearer to man than has been until recently believed

The book is a masterly piece of work, scholarly, careful, and non sensational, it shows a rare combination of scepticism with sympathy, and it ends appropriately by indicating the lines of further investigation that are at present most urgent and most promising

Medieval Maps

Reproductions of Early Manuscript Maps 1 *The Portolan Chart of Angellino de Dalorto, MCCCXXV, in the Collection of Prince Corsini at Florence* With a Note on the Surviving Charts and Atlases of the Fourteenth Century, by Arthur R Hinks Pp 12, with Chart in 4 Sheets, 24 in × 16½ in (London Royal Geographical Society 1929) 42*s* net

THE Royal Geographical Society has had placed at its disposal a fund for the reproduction of a series of selected manuscript maps, and the first issue of this series is the reproduction of the Portolan Chart of Angellino de Dalorto, which is in the collection of Prince Corsini at Florence The reproduction is to full size, and is in colour, the work was carried out by the Fratelli Alinari of Florence, by the difficult method of half tone colour plates—difficult, that is, for the registration of lettering and fine lines The result is successful, however, and the lettering is, considering the character of such old maps, fairly clear, though it must be confessed that the red names are clearer than the black It looks as if it would be desirable in future reproductions of this series to modify the process so far as concerns the black names A comparison might be made with the full-scale reproduction of the Bodleian Map of Great Britain (c A D 1300), which was carried out by the Ordnance Survey in 1870 The general appearance of this reproduction is not nearly so interesting as that of the Portolan Chart which we are discussing, but the brown names are easier to read than the black names on the chart

The original chart is drawn on a single sheepskin, about 42 inches in extreme length, and 26 inches in breadth The colours used were chiefly black, red, and green, but yellow, or gold, purple and brown were also used The outlines of the land are faint, but traceable in most parts of the map As is the custom with such charts, the face of it is covered by rhumb lines, in various colours, radiating from about twenty different points, from each of these points thirty two equally spaced, straight lines radiate There is also, drawn across the face of the chart, a system of rectangles, the lines going north and south, and east and west, spaced a few inches apart There is little or no fancy drawing, no fishes in the sea or monsters on land, though there are a few banners with arms, and the more important towns are marked by pictorial castles In fact, the chart is, in the main, a business chart, meant for use

The reproduction of the chart is accompanied by an admirable memoir by Mr A R Hinks, secretary of the Royal Geographical Society In this memoir Mr Hinks explains that he was charged by the Society with the duty of inspecting the principal fourteenth century maps now existing in the libraries of Europe, with the view of deciding which were most worth reproducing Of the eight Portolan charts of this century, or earlier, he was able to inspect seven, and chose the chart in question as being in the best style and in excellent condition, Prince Corsini readily gave his approval Mr Hinks adds brief, useful notes on the surviving Portolan charts, Catalan world maps and atlases of the fourteenth century

There may be a slight difference of opinion as to the exact date of the chart Mr Hinks, in his memoir, says, " the date [is] almost certainly 1325, though it has been read 1330 " The writer of this review took the reproduction to a scholar who is very familiar with fourteenth century Latin manuscripts, and this authority has little hesitation in reading 1330 The inscription then reads " Hoc opus fecit Angellinus de dalerto anno dni m ccc xxx de mense martii conposuit hoc "

As to the accuracy of the chart A series of cross-sea measurements, made by the writer of this review, from points easily identifiable, gave a mean scale of 75 miles to the inch for the north-east sheet of the reproduction, 84 miles to the inch for the

south-east sheet, 88 miles to the inch for the south west, and very variable numbers for the north west That sort of thing would be expected, for the north-west of Europe was relatively little known to Mediterranean sailors The mean scale of the better mapped region, that is the Mediterranean, Black Sea, and western coasts of Spain and Portugal, is about 80 miles to the inch, or a little less than one to five million An interesting feature is that there are four scales drawn for use in each of the four quarters of the chart These scales are identical, showing that it was intended that the scale should be the same all over the chart Each major division of the scale represents about 36 English miles, and each major division is divided into five minor divisions The outlines of Scandinavia, Denmark, and Scotland are very faulty, but the same remark would apply to our own Bodleian map, so far as concerns Scotland

The Bodleian map is about 46 inches long by 22 inches broad, on a single skin Its date is about A D 1300 The scale, in the better mapped portion (England), is, as nearly as may be, 1 1 million, or five times the scale of the Portolan chart The accuracy of this portion is very fair, and perhaps the map may serve to show the kind of material that was available in the better mapped regions when Angellino de Dalorto constructed his chart

With regard to the method of construction, the rectangular grid appears to represent north south and east west lines, and to that extent, as Mr Hinks remarks, the projection must tend towards a rough anticipation of Mercator But, as mentioned above, the scale is undoubtedly meant to be the same all over the chart, so that there was an attempt to combine conflicting conditions The main north south line bears symbols for north and for south and is so marked, the main east west line, at right angles to the former, bears symbols for east and west, and is so marked There can be no doubt about these two lines, and, perhaps, we may look upon them as the chief construction lines Perhaps, also, the various parts of the chart were fitted together in the manner of a jig saw puzzle, from more detailed maps, many of which no doubt existed As is usual with charts of this type, the Straits of Gibraltar are drawn considerably too far to the south, in comparison with the position of Alexandria, perhaps caused by a bending down of the western countries in the process of fitting

These matters, however, are questions of mere frame work The chart deserves to be studied in detail The names alone are full of interest, there is, for example, a wealth of place-names along the north coast of Africa As was to be expected, the interior topography of the continents depends largely on hearsay The Nile is made to rise a few hundred miles to the south of Tripoli, "hic surgit nil", and above the place where it rises is a legend to the effect that in that neighbourhood there dwell dragons, serpents, basilisks, and other horrible beasts

The anonymous benefactor, the Royal Geographical Society, and Mr Hinks, have given all those who care for ancient cartography an excellent reproduction of an important fourteenth century map, and geographers must welcome the success of this first issue of what promises to be a valuable series of reproductions of early manuscript maps

Our Bookshelf

History of the Natural History Society of Northumberland, Durham and Newcastle upon Tyne, 1829–1929 By T Russell Goddard Pp xvi + 195 + 12 plates (Newcastle upon Tyne Andrew Reid and Co, Ltd, 1929) 7s 6d net

THE Natural History Society of Northumberland, Durham, and Newcastle upon Tyne attained its centenary on Aug 19, 1929, and in order to commemorate the event the Council decided to publish a history of the Society and the Museum in which its collections are housed The work has been carried out with meticulous care by the curator, Mr T Russell Goddard, who is to be congratulated on the production of a volume which will prove to be of great interest not only to local naturalists, but also to the wider circle of those who find in natural history—in the words of Lord Grey—a sure recreation and a refreshing pleasure

The Society was founded by men who achieved permanent distinction, and many volumes of *Transactions* have been published since 1831, in which the fauna, flora, and geology of the two counties have been comprehensively dealt with The Museum is an imposing and dignified structure of classic design situated in spacious grounds It was John Hancock who made possible the erection of this beautiful building, which was completed and opened in 1884 Since 1891, a year after Hancock died, the museum has been known as the 'Hancock Museum' Among the collections, the Hancock collection of British birds is known to ornithologists throughout the world The Museum also contains the largest extant collection of drawings of birds by Thomas Bewick The Hutton collection of Carboniferous plants is of unrivalled value and contains seventy-nine type and figured specimens The geological department contains notable collections of Coal Measure fishes and amphibians, while the Permian collections, of both fishes and invertebrates, are the most extensive in Britain Some of the specimens in the ethnographical department are of interest as having been brought from Oceania by Capt Cook

The book contains brief accounts of these and other collections of unusual scientific interest,

together with lists of all the reference collections and of the new genera and species described in the *Transactions* Fourteen bibliographical sketches of the old worthies associated with the development of the Society form an attractive addition The membership of the Society has never been greater than it is at the present time, and though, like many other institutions that support museums, it has frequently been faced with grave financial difficulties, these have always been overcome, and a great tradition of public service and scientific responsibility has been developed

The book is well printed and beautifully illustrated, and is a worthy monument to the vitality of the Society and the industry of the author

Geologische Karte der Erde Von Franz Beyschlag Bearbeitet mit Unterstutzung durch die Preussische Geologische Landesanstalt 1 15,000,000 Lieferung 1, enthaltend die Blatter 1, 2, 3, 4 (Berlin Gebrüder Borntraeger, 1929) Subskriptionpreis der vollstandigen Karte, 150 g m

A satisfactory geological map of the world is of so much help that we turn with interest to the first four sheets of this map, which is being prepared for the Prussian Geological Survey by Prof Beyschlag and edited by Dr W Schriel The map will consist of twelve sheets The first section consists of the four northern sheets, which include Europe, northern Asia, and Canada, and the northern parts of the United States The scale is 1 15,000,000, so that the map gives only a general survey of the main geological divisions The colouring is clear and the primary geological structure is well shown The largest areas left blank in these sheets are in Mongolia and along the Amur Valley they are probably as well known as parts of north eastern Siberia, which are fully coloured

The map is difficult to judge without the colour sheet which is to be issued with the third part The sheets published have therefore to be interpreted by the symbols on a sheet entitled "Explanation previous for the first delivery of the Geological Map of the Globe" Some countries, such as Japan and Sicily, are shown in many colours but in small areas, the initial letters are seldom given in such cases, and without the explanation of the colours the age of the rocks has to be guessed

There are already good general geological maps both for Europe and North America, so that the sheets with the more difficult work are to come The map, however, promises to be very useful The table of formations suggests that the authors accept the existence of extensive areas of Palæozoic and Mesozoic metamorphic rocks

Selected Readings in Pathology from Hippocrates to Virchow Edited by Prof Esmond R Long Pp xiv + 305 + 26 plates (London Baillière, Tindall and Cox, 1929) 18s net

Prof Long, whose excellent "History of Pathology" was referred to in these columns last year (Nature, Oct 5, 1929, p 543), has again laid the student of medical history under his obligation by the present volume, which contains selections from important but, to many, almost inaccessible works from the dawn of scientific medicine down to the present time Antiquity is represented by Hippocrates, Galen, and Celsus, the Middle Ages by Paul of Ægina, Rhazes and William of Saliceto, the Renaissance by Antonio Benivieni, Fracastor, and Fernel, while the rest of the book contains passages from the leading British, French, Dutch, German, and American writers of the seventeenth, eighteenth, and nineteenth centuries, among whom British authors have a prominent place, as is shown by selections from Harvey, John Hunter, Baillie, Hodgson, Bright, Hodgkin, Corrigan, and Addison In the passages from French writers, who are represented by Fernel, Astruc, Corvisart, Laennec, Louis, and Cruveilhier, we miss the inclusion of selections from the works on diphtheria and typhoid fever by Bretonneau, who in the estimation of his countrymen comes only second to Laennec as a pathologist as well as a clinician

The selections from each writer are preceded by a short introduction giving an account of his significance in the history of pathology Prof Long himself has contributed the translations of the selections from the works of William of Saliceto, Antonio Benivieni, and Virchow The other translations include several contemporary versions, as in the case of Astruc, Morgagni, Corvisart, Andral, and Rokitansky

The text is interspersed with numerous portraits of the pathologists and illustrations from their works

Railway and Seaport Freight Movement with examples of British and American Practice By George Bulkeley Pp xiv + 222 (London Crosby Lockwood and Son, 1929) 28s net

Students of that department of transport which is specially associated with the transfer and handling of goods at ports between rail and ship will find Mr Bulkeley's manual an interesting and informative review of the conditions, written from the point of view of the man who is in charge of operations It is full of practical hints gleaned from a long experience in railway and dock work, and should prove a serviceable guide, particularly to beginners It is, in fact, designed as a textbook covering elementary principles, as well as being explanatory of the more complex features of port traffic organisation and operation

The author describes various modern types of freight rolling stock and freight shipping, with a consideration in the former case of motive power and service control The movement of traffic through shunting yards and sidings, to and from the quayside, is outlined and explained, and there is a description of various types of appliances for handling goods in and out of ships' holds Finally, the author discusses the subject of statistics in regard to freight movement and shows the value of a reliable system of records for guidance in operation The volume is profusely illustrated by photographs and diagrams, which form a useful adjunct to the text B C.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

The Problem of Stellar Luminosity

I ASK your permission to reply to the arguments brought forward by Prof Milne (NATURE, Mar 22) against my treatment of the problem of stellar luminosity The outcome of my investigation is a formula which predicts the luminosity of a star of given mass and radius (or mass and effective temperature) I have followed the common procedure of first employing special assumptions to make the mathematical answer definite, and then removing the assumptions by calculating the effect of the greatest admissible variation from the conditions adopted as standard—thus obtaining what is equivalent to a probable error of the prediction The calculations of luminosity must, of course, be considered in conjunction with these estimates of probable error I think that the discussion in "Internal Constitution of the Stars" of all *known* sources of uncertainty is exhaustive, and I conclude that the error is not so great as to impair the practical value of the formula I have shown that differentially the result agrees excellently with observation, but absolutely it makes all the stars about ten times too bright In view of this remaining discordance I have been as eager as my critics in searching for possible loopholes or complications If Milne's scrutiny brought to light any new possibility I should be grateful, but his criticism is not of this type He claims that there is a fundamental inadequacy in my method, so that not even a rough value can be computed in this way

In my deduction I employ those laws and conclusions of pure physics which are generally accepted as trustworthy I think that most physicists will assent to my including among these the conclusion that matter in the usual stellar conditions of temperature and density behaves as a perfect (or slightly superperfect) gas—notwithstanding the doubts of my friend Sir James Jeans But there is one result that as yet ought only to be used tentatively, namely, the physical calculation giving the absorption coefficient or opacity of matter in stellar conditions If we accept it, my formulæ determine the luminosity, if we mistrust it, the application of my formulæ is inverted, and we use the observed luminosity to determine the intrinsic opacity of the material in the interior In the opening paragraph of his long *Monthly Notices R A S* paper, Milne proclaims his main conclusion that it is not possible to infer from the observed masses, luminosities, and temperatures the value of the absorption coefficient for the stellar interior, and in his letter to NATURE he puts the same challenge in the converse form, denying the dependence of luminosity on internal opacity

Now the greater part of Milne's letter is occupied with a problem which is only indirectly related to my investigation, namely, the problem of supplying energy (presumably from sub atomic sources) at a suitable rate to maintain the star in an approximately steady state for vast periods of time I think I was the first to insist on the difficulty of this regulation of supply (NATURE, Mar 21, 1925, p, 419, May 1, 1926, Supp) Many dilemmas similar to those touched on by Milne are collected and surveyed in "Internal Constitution of the Stars", Chap xi But these difficulties in reaching a satisfactory theory of evolution and in accounting, for example, for the Hertzsprung-Russell diagram, do not concern my investigation of luminosity, which depends only on the present equilibrium Milne complains that my scheme of equations does not automatically provide that $L = \int \epsilon dM$ shall be satisfied Of course, it does not As well might he demand that the equations by which the flow of water in a main is calculated from the head of pressure should automatically control the machinery of the pumps (It is not very clear whether in referring to contracting stars Milne takes ϵ to mean the actual rate of liberation of sub atomic energy or the rate from a fictitious distribution of sources which he introduces in a formulation of the cooling problem, with the latter meaning $L = \int \epsilon dM$ is automatically fulfilled without reference to my equations) My equations refer to ordinary equilibrium and they are indifferent as to whether the slow secular changes proceed with a time scale of a million or a thousand million years

Only at one point do considerations of evolution and energy supply impinge on my theory of stellar luminosity If fully known, they would enable us to assign an exact value to a certain factor (α in my formulæ, η in Milne's version), which depends on the relative distribution but not on the magnitude of the energy sources As it is, we leave this factor undetermined within limits, the extreme range is about $2\frac{1}{2}$ 1, and this is included in the uncertainty of prediction above mentioned Thus the one really vital sentence in Milne's letter is, "Similar considerations show that the luminosity of a star cannot be even roughly independent of the relative distribution of energy sources" That is to say, α and η have unrestricted range This throws over a conclusion on which Milne Jeans ('Astronomy and Cosmogony", p 101), and I had all reached agreement Instead of following up this assertion with the expected justification, he proceeds to argue that the luminosity depends on the radius (As this is what my formulæ assert, I have no need to dissent) It is strange that Milne should leave his most essential assertion unsupported both in his letter and in his longer paper It is strange that he should think it unnecessary to say why he rejects my calculation of the amount of dependence Strangest of all, he treats with equal contempt his own paper on "Stellar Equilibrium and the Influence of the Distribution of Energy production" (*Monthly Notices, R A S*, vol 87, p 708)

Finally, I can scarcely agree that Prof Milne has disproved my conclusion that the uranium model is unstable His objection is that physically a star cannot "contract indefinitely", sooner or later it must find a (contracted) configuration of equilibrium By the same argument Humpty Dumpty's position on the wall was not unstable, ultimately he found a new configuration of equilibrium A S EDDINGTON.

Observatory, Cambridge,
Mar 17

The Relation of Fluidity of Liquids to Temperature

NONE of the formulæ proposed for the effect of temperature upon the viscosity of liquids has secured general acceptance, in the sense of permitting satisfactory comparison of liquids

In the shearing over unit area defining viscous resistance, we may suppose at any moment an equilibrium between undeformed and deformed molecules, to which the Boltzman distribution function applies This leads to an expression relating fluidity to temperature of the form

$$\log \phi = -\frac{k}{T} + C,$$

where T is temperature absolute, and k and C are constants This expression can only be a first approximation, since it assumes k and C independent of temperature None the less, it was found to represent the relation of fluidity to temperature for every liquid so far tested—more than fifty—over a very wide range of temperature with an accuracy generally comparable with the experimental error Deviations become considerable as the temperature approaches the freezing-point

This result confirms Prof A W Porter's observation that $\log \phi$ plotted against $\log p$, where p is vapour pressure, gives a straight line, and specialises his deduction that some function of ϕ should have the form $f(\phi) = \frac{k}{T} + C$ (*Phil Mag* [vi], **23**, 458, 1912)

From the derivation from the distribution function, it appears that k, the slope of the line, should be a work function involving the specific heat of the liquid A simple work function which has given very interesting results is obtained as follows The observed specific heat C_p—mean value over temperature range—refers to unit mass Hence specific heat per unit volume is $C_p\delta$, where δ = density, mean value over temperature range The heat per molar area is obtained as $C_p \times (M\delta)^{2/3}$, where M is the formula molecular weight, that is, uncorrected for possible association or dissociation

It follows that to a first approximation, if k be the slope of the line $\log \phi \propto 1/T$, the expression $\frac{\text{Specific heat} \times (M\delta)^{2/3}}{k}$ should equal a constant K, the same for all normal liquids, while a relative indication of molecular association should be obtained as $a = \left(\frac{K}{K'}\right)^{3/2}$ for deviating liquids

The data available—principally the fundamental studies of Thorpe and Rodgers—give quite good confirmation of this relation For liquids which have been previously deduced to be 'normal' by other methods (cf W E S Turner, "Molecular Association" Longmans Green and Co) the values of the molar work function, in arbitrary units, ranged from 21 9 to 19 8 The values of the association factor a calculated for the abnormal liquids are generally of the right order of absolute magnitude, and place them in a relative order agreeing reasonably well with such orders as are obtained by other methods, it is admitted that these are somewhat discordant Thus the following values for a were obtained for typical cognate series of compounds

Substance	Formula	a
Water	H_2O	3 51
Methyl alcohol	CH_3 OH	2 70
Ethyl alcohol	C_2H_5 OH	3 15
Propyl alcohol	C_3H_7 OH	3 04
Butyl alcohol	C_4H_9 OH	2 95
Iso butyl alcohol	C_4H_9 OH	3 52
Formic acid	H COOH	2 66
Acetic acid	CH_3 COOH	1 64
Butyric acid	C_3H_7 COOH	1 35
Iso butyric acid	C_3H_7 COOH	1 66

Except for methyl alcohol, the trend of these values is regular and plausible The alcohols show a slow declination of association with increasing molecular weight, the fatty acids a more rapid one, while in both cases iso bodies show increased association compared with normal bodies

It is realised that the association factors found can be only relative, since the temperature variation is not allowed for It may be remarked that on considering modifications of the formulæ to include this variation, it was found that the published data on the variation with temperature of the specific heats of liquids appear to be very sparse and discordant

My thanks are due to Dr R C Houck for essential assistance in testing the formulæ suggested Should further applications give encouragement, a joint paper will be published in the *Journal of Rheology*

S E Sheppard

Research Laboratory,
Eastman Kodak Company,
Rochester, N Y,
Feb 3

Since my letter of Feb 3, a further search of the literature has shown that the specific form of Porter's function,

$$f(\phi) = -\frac{k}{T} + C, \text{ putting } f(\phi) = \log \phi,$$

has been used before The original application is by Señor J de Guzman, "Relación entre la Fluidez y el Calor de Fusion" (*Anales de la Sociedad Española de Fisica y Quimica*, 11, p 353, 1913) The author refers to a future article to be published jointly with Prof C Drucker, of Leipzig, in whose laboratory he was then working This article does not appear to have been published, so far as I can ascertain, but in an article, "Untersuchungen uber Fluidität" (*Zeit phys Chem*, 92, 287, 1918), Prof Drucker recapitulates and expands the application of the formula, used as an integration between temperatures T_1, T_2 of its differential form

$$\frac{d \log \phi}{dT} = \frac{w}{RT^2}$$

to deduce the work function w, which as previously stated by Señor de Guzman, is found to be nearly equal in many cases to the *molecular latent heat of fusion*

On the other hand, the form of the work function suggested in my letter above appears correct, to an equal degree of approximation Certain interesting consequences follow from this, with which I hope to deal more fully elsewhere

I shall not regret having unwittingly assumed some novelty in the specialisation of Porter's formula, if so doing should help to affirm and extend the previous work of the authors cited S E S

Feb 15

[When Dr Sheppard sent the above communication for publication, he was, of course, unaware that Prof Andrade had recently been giving attention to the relation between temperature and the viscosity of liquids, and had stated preliminary results of his investigations in Nature of Mar 1 Since that letter was published, we have received several others discussing some points raised in it, and we hope to include these in an early issue, together with Prof Andrade's remarks upon them —Editor, Nature]

The Age of Iron Meteorites

If meteorites are scattered portions of our solar system, derived from some disintegrated planet or from the earth, then their age cannot be greater than that of the solar system This is assumed to be about 3×10^9 years at the utmost If, however, meteorites come from other stars, it is possible that the period

of their solidification could date back some 10^{13} years A determination of the age of meteorites can therefore bear on the question of their source

Of the radioactive methods of age determination the lead method is here inapplicable , but Strutt's well known helium method is practicable if the sensitivity of the measurements be suitably increased In any event, it is essential not simply to heat the meteorite, but to bring it into complete solution A description of an apparatus, such as is required for the performance of this operation under absolutely air-free conditions, was given two years ago, together with some results obtained (*Zeits für Electrochemie*, **34**, 645 , 1928 , see also NATURE, **123**, 879 , 1929, as well as the communication of Dubey and Holmes (NATURE, **123**, 794 , 1929) concerning two helium measurements made in our laboratory)

At that time we confined ourselves to the determination of the helium content, and relied upon the meteorite analysis of other investigators for the radium values Owing to the fact that both measurements can vary somewhat in individual pieces of a meteorite, an element of uncertainty enters into the calculation In the course of our research we have, therefore, so far improved our method that in one and the same sample both the helium and the radium content are ascertained Our process of bringing the meteorite into solution remains essentially the same The helium so freed is now, however, measured by means of a resistance manometer developed from that designed by Pirani and Stern , with this 10^{-7} c c of helium can be determined with a 2 per cent accuracy (The limit of the qualitative test for helium by our method is of the order of 10^{-10} c c , see *Zeits phys Chem* , 134, 353 , 1928) The electrometric method employed for measuring the radium content permits an accuracy of about 10 per cent in measurements of 10^{-13} gm of radium All the reagents used in the solution process have been so freed from radium that their activity cannot occasion any error

In the following table the results of our work are briefly summarised In order to complete the series, we include four earlier determinations (in which we ascertained the helium, but other investigators the radium, value) , and also the helium values of six meteorites, of which the radium still remains to be measured These are added because the helium content is in itself of interest in the study of meteorites , it varies within very wide limits in meteorites of different source, and can therefore be used to test the common origin of fragments separately distributed on disintegration (See, for example, the agreement of helium values for the two masses of Mukerop and Löwenfluss) The only meteorite (Savik) in which both the helium and radium content is so abnormally low that we failed persistently to detect these elements qualitatively is also tabulated All the age values which were calculated from helium and radium content ascertained in the same sample are indicated by a star

It has generally been considered that the helium method gives only a minimum age estimate, on account of a possible helium leakage This objection cannot be raised in the case of iron meteorites (to which we have therefore confined ourselves for the present) because we have demonstrated that even red-hot metals are not penetrable by the smallest amount of helium , even after palladium had been allowed to glow for several hours, the quantity remained under 10^{-10} c c (see *Zeits phys Chem* (B), I, 253 , 1928) As further evidence we heated Mount Aylıff, the meteorite richest in helium, for twelve hours at 800° C , and ascertained that less than 5 per cent of helium was released This also explains why earlier workers who attempted to detect the helium content by mere heating found values far too low , Strutt found in Staunton Co less than 1 6 × 10^{-6} c c per gm , although it contains nearly twelve times that amount We do not believe, therefore, that our determinations of iron meteorites can be too low, owing to helium loss A possible thorium content (probably, however, too small to effect appreciably the calculation) would still somewhat reduce the age value

It will be noticed that some age values given in the table are higher than those found in any previous

Name	Type	He per gm in 10^{-6} c c	Ra per gm in 10^{-14} gm	Age in Millions of Years
Savik	Om	<0 0002	<0 2	—*
,,	Om	<0 0002	<0 4	—*
Mukerop, Farm Goamus	Of	0 43	1 3	100*
Mukerop, Farm Gröndorn	Of	0 49	—	—
Löwenfluss	Of	0 47	—	—
Toluca	Om	1 2	21	16
Seeläsgen	Ogg	2 0	4 9	120
São Julião de Moreira	Ogg	2 0	—	—
San Martin, Chile	—	2 13	1 4	420*
Santa Rosa, Columbia	Ob	3 02	—	—
El Inca	Om	4 0	2 0	550*
Augustinowka	Off	5 21	—	—
Arispe	Ogg	7 22	1 3	1500*
Mount Joy	Ogg	9 7	4 7	570
N'Goureyma	Ob	13 91	2 9	1250*
Cocke Co	Og	14	4 0	930
Hraschina	Om	14 9	2 6	1450*
Sacramento Mts	Om	15 03	2 5	1550*
Crow Creek	Og	17 35	—	—
Staunton Co , Mass III	Om	18 82	2 1	2150*
Staunton Co , Mass V	Om	18 92	2 4	2000*
Independence Co	Om	19 28	4 1	1200*
Burlington Co	Om	19 31	3 6	1400*
Nelson Co	Ogg	20	1 8	2600
Thunda	Om	28 57	2 3	2800*
Mount Aylıff	Og	35 81	2 8	2900*
,, ,,	Og	35 96	3 2	2600*

application of the radioactive methods (The lead method gave a maximum of 1600 million years, the helium only of 570 million years) Although our iron meteorite results range up to 2900 million years, nevertheless not one is found to be older than the age of the earth The solidification date of all meteorites so far studied accords well, therefore, with the assumption that iron meteorites originate not from distant celestial bodies, but from our solar system

F PANETH
WM D URRY
W KOECK

Chemisches Institut der Universität,
Königsberg i Pr , Mar 3

The Planet discovered at Lowell Observatory.

LAST week I indicated the basis of Lowell's prediction of an unknown planet exterior to Neptune Further consideration of Lowell's memoir leaves me of the opinion that the residuals in the motion of Uranus are too small for the orbit of a disturbing planet to be predicted with any certainty It may be of interest to give the opinion of Newcomb, who, with

his assistants, was responsible for the tables of all the major planets the positions of which are given in the *Nautical Almanac* In the introduction to his tables of Uranus he wrote "These tables of Uranus are based on elements derived from meridian observations of the planet from the time of its discovery by Herschel in 1781 to the opposition of 1898 The outstanding residuals between theory and observation, left in the solution of the equations, sometimes amount to one second of arc It is not possible at the present time to decide whether these differences are real or whether they arise from the errors of the ephemeris of comparison, which, between 1830 and 1872, was that derived from Bouvard's tables The observations since 1860 seem to be represented with great exactness" No great importance need be placed on the fact that Lowell used three normal places earlier than 1781 and that he included observations up to 1910 In justice to him, however, it should be stated that he made no claim to very great accuracy in the prediction

It is impossible to deny the existence of unknown exterior planets, but it appears to me quite unwarranted to jump to the conclusion that the newly found object is a major planet with a mass between that of the earth and Neptune It is not easy, on the other hand, to conjecture the nature of the body which for nearly two months has simulated in motion a planet distant more than 40 astronomical units If we imagine a body in opposition distant 49 units from the sun, moving in a circular orbit, its path would be parallel to the earth's path, but its speed only one seventh Consequently, it would appear to retrograde about 60″ a day After two months the earth's motion would be inclined at an angle of 60° to the direction of the planet and the apparent motion would be reduced to about half The question is, What sort of body other than an exterior planet would appear to move in this way? It is quite easy to answer that no permanent member of the solar system inside the orbit of Uranus could behave in this way The observations reveal that the object is distant If it were 25 units away, it would require to move at about half the earth's speed to appear nearly stationary at twice its distance But an object 25 units from the sun moving at half the speed of the earth would soon pass out of the solar system The inevitable conclusion seems to be that the body is either moving in an approximately circular orbit at the distance announced, or in a nearer orbit with parabolic or hyperbolic velocity and near perihelion

From all the information now available, the object is definitely a small planet, possibly comparable to the planet Mercury in size No known comet would appear so bright at so great a distance

From the newspaper reports it appears that the Lowell observers have spent a good deal of time during the past year in searching for the predicted planet, and that they have in the meantime discovered, as one would have expected, many minor planets which by their comparatively rapid motion have quickly shown their true character The new object, whatever its real nature, will be of importance, for if only a comet, it will be no ordinary one The comet which at present holds the record for greatest perihelion distance is 1927 *j*, which never approaches the sun nearer than 5 5 units and moves in an orbit which does not differ so very greatly from a circle The fact that, of the five known comets with greatest perihelion distance, four were discovered so recently as 1914, 1925, 1927 (two) is surely significant It looks as if long exposure photographs are revealing a number of faint objects inside the solar system which would otherwise remain unknown, and possibly we may soon have better knowledge from which to judge the distribution of comets in our system

With regard to comet 1927 *j*, it may be noted that the discoverers, Schwassmann and Wachmann, described it as of magnitude 13 to 14 with a well-defined nucleus and a circular coma about 2′ in diameter It appears not unreasonable to believe that the new object, which is described as of magnitude 15 to 16, is a still more distant object It is quite reasonable to expect that diligent search amongst the faintest objects we can photograph may reveal many faint comets at a great distance

The stumbling block in accepting the new object as the planet predicted by Lowell is its feeble luminosity Lowell stated that his planet would have "a visibility of the 12 13 magnitude according to albedo; and a disc of more than 1″ in diameter" The magnitudes reported vary from 15 to 16 0—the latter being on the international photographic scale A difference of three magnitudes in the brightness corresponds to a factor of 63 in the volume It is difficult to explain this by low albedo and high density, as the mass, if wrong by a factor of more than 2, would make the prediction meaningless The Lowell Observatory will in any case be congratulated on the discovery of what may be the most remote object ever observed in the solar system

J Jackson

Royal Observatory,
Greenwich, S E 10,
Mar 23

A Method of Investigating Gas Exchanges of Living Tissues

Few, if any, really simple methods have been proposed for the simultaneous estimation of the carbon dioxide evolution and oxygen uptake of living tissues in which it is possible to maintain the composition of the gas mixture surrounding the tissue constant, and at the same time detect a rapid change in rates of gas exchanges The method outlined here has been found to be very simple, rapid, and trustworthy

The principle of the method is as follows a gas mixture circulates in a closed system over the material under investigation, and through a solution of barium hydroxide Since the carbon dioxide is thus absorbed, there is a reduction in volume of the gas mixture due to the absorption of oxygen by the tissue This causes the level of liquid to rise in a manometer placed between the closed respiration system and another closed volume of air (the compensator) The liquid is an electrolyte, and when it rises a small amount (about 1 mm), it makes contact with an electrode from which oxygen starts to be evolved, further decrease in volume of the system due to absorption of oxygen is thus prevented by this automatic electrolytic addition of oxygen which takes place at the same rate as that at which the oxygen is absorbed by the tissue

This rate is measured by measuring the current used in the course of the electrolysis by either finding the volume of hydrogen or weight of silver simultaneously set free

The rate of carbon dioxide emission of the tissue is found by observing the change in electrical resistance of the barium hydroxide solution, which rapidly increases owing to the conversion of the hydroxide into insoluble barium carbonate

It is essential that the platinum black electrodes should not remain long in contact with the baryta, more particularly while the gas stream is bubbling through it, as it is found that the barium carbonate

precipitate tends to form on any solid surface placed in the solution The electrodes thus become coated with barium carbonate and the 'cell constant' rises towards infinity This is readily prevented by a simple device the electrodes are kept in mercury at the base of the baryta tube in which the carbon dioxide is being absorbed When it is desired to estimate the quantity of carbon dioxide which has been absorbed, the gas stream is stopped and the mercury is lowered and the baryta comes in contact with the electrodes, the conductivity is measured, and the electrodes are again covered with the mercury and the gas stream is started again

The diagram of the apparatus is almost self explanatory Absorption of oxygen by the plants causes the solution in the manometer CD to rise into tube C, thus bringing the electrode c into electrolytic connexion

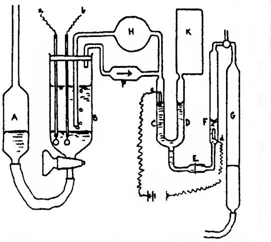

FIG 1 —A, tube for altering level of mercury in B B carbon dioxide absorption tube CD, manometer E, parchment membrane G, gas burette H, plant chamber K, compensator P, circulating pump Electrodes a and b are connected to a Wheatstone bridge

with d The parchment membrane E allows this movement of ions, but prevents changes in the gas pressure in the tube F from affecting the volume of the gas in the circulating system and compensator The gas burette G serves to estimate the hydrogen evolved simultaneously with the oxygen

The volume of the circulating gases fluctuates to an extent of about 0 07 c c on each side of the mean volume, and this defines the limit of accuracy with which the rate of oxygen intake can be estimated

The relationship between the resistance of the baryta and the quantity of carbon dioxide which it has absorbed is most conveniently obtained by calibrating the apparatus with known amounts of carbon dioxide The magnitude of the change in resistance for a given quantity of carbon dioxide increases as the process of absorption proceeds Using $N/20$ baryta, 1 mgm carbon dioxide brings about an increase in resistance of roughly 10 per cent

It is hoped that full details both of the calibration and 'rapidity of response' of the apparatus will shortly be published

It may be noted that the fact that the circulating gas system is closed throughout the course of the experiment makes this method particularly accurate, and useful when gas mixtures other than air are used in the investigation T A BENNET CLARK

School of Botany,
Trinity College, Dublin
Feb 28

Crossed Connexion of the Cerebral Hemispheres with the Muscles and Sense Organs.

I WISH to thank Dr Creed for his letter in NATURE of Mar 1 with its references

I am afraid that in my attempt to be brief I may have misled Dr Creed in one or two details I agree with him that the crossing of both afferent and efferent impulses seems a very clumsy arrangement, but my desire was to suggest a way in which this remarkable state of affairs might have been brought about

I did not mean to suggest that the median eye is the forerunner of the two lateral eyes In view of the number and variety of eye like structures in invertebrates, it seems that such organs can be easily developed, in fact, in *Sphenodon* there are two lateral eyes as well as a single median one The parapineal organ may be the remnant of the primitive median eye, and if so the well developed structure in *Sphenodon*, even if it is not functional, is worthy of investigation. Perhaps some comparative anatomist can throw light on this possible relationship I did not refer to *Sphenodon* previously because the crossed connexion occurs in fishes, hence the origin of that condition must have been in a more primitive organism If the pineal eye of *Sphenodon* does represent the same structure as the eye of an ascidian larva, it is curious that the organ seems to have nearly disappeared in fishes

I look upon the original crossing as efferent There is no need in the ascidian larva for an afferent crossing, as the optical images would be formed on the crossed side Where the crossing occurs and how many neurones are involved in the path to the muscles, I do not know, but in so far as the impulses are concerned with the production of movement they are efferent

When the crossed connexion had been established, the parts growing from that region would all be crossed and the afferent impulses would have to cross in order to link up with the efferent paths It is remarkable, however, that a new uncrossed system did not develop when lateral eyes became predominant As pointed out by Dr Creed, Ramón y Cajal's suggestion is out of harmony with the cortical distribution of the retinal areas in man

H E ROAF

London Hospital Medical College,
Mar 10

Indeterminacy in Physics

THE Principle of Indeterminacy in physics, to the history of which Sir Joseph Larmor has directed attention in NATURE of Mar 8, is sometimes referred to as though it might develop so as to dissolve all physical laws It is well to point out its limitations Its present phase is no more than the search among physical statements for their minimum content, rejecting repetition and superfluity From this point of view it is the necessary continuation of the chapter of upheaval of ideas introduced by Relativity, which dissolved so much

It is only by mathematics that superfluous statements, so subtle that they have hitherto evaded detection, can safely be analysed But mathematics is a closed chain of argument that reveals nothing that is not put into the chain originally, and physics, upon which it works, has been so far explored, that apart from detail, we know what it is going to say What it is going to say is, to attempt to describe the universe without Will or Purpose It does so, not because anyone believes that to be possible, but because those things are unmanageable by mathematics and have,

therefore, been left out expressly from the mathematical chain Hence whenever physics attempts an ultimate picture, the result is jejune, or absurd, according to the writer's taste In any case it is incredible "I had rather believe all the fables in the Legend, and the Talmud, and the Alcoran, than that this universal frame was without a mind"

Physics, having excluded purpose from its view, when it has no more to say, presents a scheme which is purposeless and therefore meaningless, both in its beginning and its end It is a self consistent scheme, but it is in no sense satisfying The conclusion to draw from it is, apparently, that we must try again upon a broader basis, little as we know how to do so In the meantime, all searches aimed at weeding out unjustified precision in our statements of natural 'law' fall into a class of lower importance, an exercise merely technical, interesting to those that are interested in that kind of thing

R A SAMPSON

Royal Observatory,
Edinburgh, Mar 8

The Maladaptation of Trout Spermatozoa to Fresh Water.

A FEW years ago, when I was investigating sex ratio in trout, some facts came to light which I intended to pursue further, but as there seems no opportunity at the moment of doing so, I feel it is worth putting them on record Gray (*Jour Physiol*, **53**, 308, 1920) had already pointed out the remarkable fact that artificial insemination of trout eggs secured a much higher percentage of fertilised eggs than did natural fertilisation, and had shown that this was due to the extremely short time (1½ 2½ minutes) for which the sperm remain active

Struck by this observation, I made a few experiments with sperm in different solutions I need not go into details the salient point which emerged was that both sodium chloride and Ringer's solutions as well as somewhat diluted sea water enormously prolonged the sperms' period of activity Instead of about two minutes, it might run to ten or twenty minutes, and in sea water diluted with three parts of tap water, to half an hour or over Undiluted sea water was less favourable Details of optimum salt composition, osmotic pressure, hydrogen ion concentration, or of possible antagonistic salt action remain to be determined

The general fact emerges, however, that the trout is an animal which, though somatically fully adapted to fresh water life, is very imperfectly so adapted in its reproduction, its sperms being many times more efficient in a medium intermediate between its present and its ancestral environment

J S HUXLEY

King's College, Strand,
London, W C 2, Mar 11

Curling

THE letter on the flight of a curling stone by Messrs Macaulay and Smith, in NATURE of Mar 15, seems to require a little filling out As an old curler, and one who has been much 'in the house', I may perhaps be pardoned for taking part in a subject the mathematics of which are above my head First, on good ice covered with ever so little frozen mist a stone 'borrows', bends, or curls far less than one passing over dry, clean ice, or very clean ice *just* on the thaw The amount of spin (handle) put on one stone without effecting the curl of that stone may be too great for another stone, and cause it to keep its original direction I have seen old stones, with the polish off them, take a lot of curl, even when played on the side with next to no cup My own view is a stone tends to turn on its outer edge and so to roll inwards, the spin of the stone when great reduces this outward turn, the tendency of the stone to follow the line of least resistance is slight, perhaps the 1 ft 11 in arrived at by Messrs Macaulay and Smith

Before leaving this interesting subject there is one more point worth consideration Should a stone be delivered with the weight of the body behind it, as from the hack, or is it more economical in energy to swing it, as from the crampit? The finest exponent of the game I have seen of late years does both, but his swing, if not followed by a forward slide of his body, every once in a while, causes him to 'drop' his stone If the flight is worth considering in one pair of dimensions, could some one give its correct line in the other?

C W RICHARDSON

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Horse and Fowl Hæmoglobin

DURING the course of a spectrographic examination of horse and fowl hæmoglobin, we have noted that the absorption band having its peak at 4100 A for oxyhæmoglobin and 4300 A for hæmoglobin in solutions of the above compounds, does not appear when washed corpuscle suspensions containing hæmoglobin and oxyhæmoglobin in similar concentrations are examined Furthermore, the absorption which begins at 2500 A in solutions of horse hæmoglobin also is absent when hæmoglobin or oxyhæmoglobin is observed in washed cell suspensions The specific bands in the visible regions of solutions of the above pigments are observed in the washed cell suspensions in their usual location

Apparently there is, in the case of hæmoglobin in the cell, a possibility that it is in combination with some constituent of the corpuscle This problem is one of several concerning the blood pigment for which we are attempting to find a solution

A BRUCE MACALLUM
R C BRADLEY

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An Anthropological Congress.

THROUGH the courtesy of a friend, I have had the opportunity of seeing a copy of a circular of invitation, dated Paris, Feb 15, 1930, to an anthropological congress described as *XV^e Congrès Internationale d'Anthropologie et d'Archéologie Préhistorique IV^e Session de l'Institut International d'Anthropologie Portugal, 1930* This invitation is signed by the president and secretaries of the Institut International d'Anthropologie, and is issued from its address in Paris Among the 'comité d'honneur' is one of the survivors of the 'permanent committee' of the *XIV^e Congrès International* (Geneva, 1912), another represents Switzerland on a "comité international de préparation scientifique des sessions", but there is no other apparent link with the older series of congresses

In view of the leading article on these congresses in NATURE of March 1, readers may be interested to have this further information

JOHN L MYRES.

Royal Anthropological Institute,
London, Mar 15

The Nobel Prizes for Research Work in Science

HISTORY OF FOUNDATION AND CONSTITUTION OF COMMITTEES

ALFRED BERNHARD NOBEL, engineer, chemist, inventor, industrialist, philanthropist, was born at Stockholm, Sweden, on Oct 21, 1833, he died at San Remo, Italy, on Dec 10, 1896, aged sixty three years The terms of his will, covering an immense capital sum, instituted an annual allocation of money prizes, of which the essential principle was their application for and towards the greatest benefit of mankind From inquiries which reach us from time to time, and from comments made upon awards of the prizes, it appears that the nature and work of the Foundation are not clearly and widely understood We think, therefore, that a useful purpose will be served by giving a sketch of Nobel's career and presenting in a compendious form, the main decisions and articles embodied in the Code of Statutes of the Nobel Foundation, which are recurrent in operation, so far as they are likely to concern scientific workers in the domains of physics, chemistry, physiology, and medicine

The story may appropriately begin with the discovery in 1846, by Ascanio Sobrero, of Turin, of nitro glycerine The process of manufacture was described in a communication to the Turin Academy of Sciences in February 1847, and therein Sobrero mentions its explosive properties In a lecture given about this date, before a scientific congress in Venice, he stated that "it is not yet possible to say anything as to the use that may one day be found for this liquid substance, which can be exploded by a shock, future experience alone will show us" Down to the early 'sixties, nitro-glycerine was regarded much in the aspect of a scientific curiosity, and its use as a powerful explosive was not contemplated The resourcefulness, patience, and inventive genius of Alfred Nobel wholly changed the situation

A recently issued English edition of "The Life of Alfred Nobel", by Prof H Schück and R Sohlman,[1] translated from the German edition of Dr Muelbe, supplies details of Nobel's first Swedish patent, and of those experiments and developments ensuing which revolutionised the technique of explosives Particulars will also be found there as to the manufacture of dynamite (1863), ballistite (1888), and other explosive materials

This "Life" is a welcome compilation, affording so far as possible an authentic account of Nobel's family history and upbringing, and of the activities which dominated his career Hitherto, details have appeared, more or less uncertain and incomplete But this issue bears the authority of the Nobel Institute, whilst the authors are specially qualified for their task Two forewords, by the late Dr Gustav Stresemann, and Sir Austen Chamberlain, respectively, are of interest in relation to the subject of international peace

[1] "The Life of Alfred Nobel" By H Schück and R Sohlman. Translated from the German of W H v d Muelbe by Brian and Beatrix Lunn Pp ix+353+18 plates (London William Heinemann, Ltd, 1929) 21s net.

It appears that owing to the reserve which was characteristic of Nobel, a biography of him could only be, in a sense, fragmentary, since extensive periods of his life's history remain as uncharted areas on a map In 1893 the University of Uppsala conferred upon him a doctorate of philosophy He furnished then a short autobiography, breaking silence, as follows "The undersigned was born on the 21st October 1833, he acquired his knowledge in private studies, and did not attend any secondary school He devoted himself particularly to applied chemistry, and discovered explosives known under the names of dynamite, and smokeless powder called ballistite and C 89 Since 1884 he has been a member of the Royal Swedish Academy of Science, and is also a member of the Royal Society (London)[2] and the Société des Ingénieurs Civils in Paris Since 1880 he has been a Knight of the Order of the Polar Star He is an officer of the Legion of Honour"

Although a Swede, whose alternative tongue was Russian, he wrote German, French, and English in faultless style To say that he seems never to have had leisure to live may appear paradoxical, nevertheless it has elements of truth Owning a native kindliness of heart, many deeds of sympathy with affliction sprang therefrom He was free from methods of dictatorship, and observed strict rectitude in business operations, and he held open and fair dealings with all in his employ

Nobel was conscious that his scientific discoveries, besides their technical and industrial applications, might have far-reaching overt implication Incidentally, he had placed in the hands of internationals ways and means for new destructive agencies amongst mankind in general The knowledge seems to have bred a haunting fear, and melancholy dread, intensified with passing years Peace between peoples became a subjective necessity of his being Possibly, after all, science and philosophy were in the middle distance only, and not in the foreground of his thoughts

"I have been wondering", he wrote (1892), "why the rules governing a duel between individuals should not be applied to a duel between peoples" Disarmament, he believed, could only be achieved by very slow degrees Somewhat later he had reached this conclusion "I am beginning to believe that the only true solution would be a convention under which all the governments would bind themselves to defend collectively any country that was attacked" His final will provided (through prize awards) for the promotion of friendly relations between the peoples, for the abolition or reduction of standing armies, and for the formation and increase of peace congresses

It is of interest to recall that on May 21, 1875, Nobel attended the Society of Arts in London, and read a paper "On Modern Blasting Agents", and it was announced as by the founder of the nitro-

[2] Dr Nobel was not a foreign member of the Royal Society of London

glycerine industry The chairman, Mr (afterwards Sir) Frederick Abel, advised the audience that the great experience of Mr Nobel, both from a practical and scientific point of view, entitled his views to very great consideration There, were, however, debatable points Abel summed up the discussion that took place at considerable length At the ensuing annual general meeting (June 30, 1875) Nobel was awarded the Society's silver medal for this paper Nobel had remarked that the foregoing was the only scientific memoir he had ever written He did not do himself justice in this respect Earlier, in 1865, he communicated a paper to the Paris Academy of Sciences, published with the following title "Résultats des expériences de sautage faits avec la nitro-glycérine, à la mine de la Vielle-Montagne" Also, in 1868, he attended the meeting at Norwich of the British Association and read a paper on "Dynamite, a Recent Preparation of Nitro glycerine, as a Blasting Agent" This was published in brief abstract

Nobel's comparatively early death was not unexpected From his earliest youth he had been delicate When only twenty he underwent treatment at a spa, oftentimes repeated Strenuous work and constant travelling from country to country naturally took their toll In 1893 he reached the age of sixty and heart trouble became more frequent From Paris he wrote, "It seems an irony of fate that they should be prescribing nitro-glycerine internally for me" and this to his sister-in law, Ludwig Nobel's wife "You are anchored in contentment I drift about without rudder or compass, a wreck on the sea of life, I have no memories to cheer me, no pleasant illusions of the future to comfort me"

The student of scientific biography will observe a curious parallel in the life story of Alfred Nobel and that of James Smithson, founder of the Smithsonian Institution, Washington, whose patrimony, though meagre by comparison, was designated (1826) for "the diffusion of knowledge among men" Each was unmarried, each of marked idealistic fibre Bodily infirmities were alike common Both careers came to a close in Italy, a land foreign to birth

By his own wish Alfred Nobel was buried at Stockholm in a grave in the northern churchyard where his parents and a brother had been interred Thus, the spirit of patriotism was preserved in the end

Design of Nobel's Will

It was provided in the will (drawn on Dec 27, 1895) that the interest on the capital sum available should be awarded annually in prizes to those persons who shall have contributed most materially to benefit mankind during the year immediately preceding Further, that the interest should be divided into five equal amounts

In the domain of science the appointments were three in number, specified as under

(a) One share to the person who shall have made the most important discovery or invention in the department of physics

(b) One share to the person who shall have made the most important chemical discovery or improvement.

(c) One share to the person who shall have made the most important discovery in the department of physiology or medicine

Further, the will stipulated that the prizes for physics and chemistry should be awarded by the Swedish Academy of Science, Stockholm, the prize for physiology or medicine by the Caroline Medical Institute, Stockholm "I declare it to be my express desire", wrote Nobel, "that, in the awarding of prizes, no consideration whatever be paid to the nationality of the candidates, that is to say, that the most deserving be awarded the prize, whether of Scandinavian origin or not"

The instructions of the will settled the form and scope of the Nobel Foundation, which was ushered into being in the year 1900, after prolonged deliberations The Royal Academy of Science, Stockholm (K Svenska Vetenskaps-Akademie) one of the two corporate bodies with whom is vested the adjudication of the three prizes in science, was founded in 1739 The functions of the Academy are to encourage the pursuit and the development of the sciences, and also to spread a knowledge of them through scientific papers and monographs The King is patron, and there are 100 Swedish and Norwegian members and 75 foreigners The Caroline Medical chirurgical Institute, Stockholm (K Karolinska Institutet) was founded in 1815 It corresponds to a university medical faculty, and has the same standing as the medical faculties at Uppsala and Lund

The Statutes of the Foundation provide that it is within the power of each corporation entitled to adjudicate prizes, to determine whether the prize or prizes it has to award might be granted to some institution or society

Nobel Committees

An elective Nobel Committee for each of the three scientific prize sections exists to promote the obligations devolving yearly upon the Stockholm institutions, consisting of three, four, or five members The committees receive and make suggestions respecting the grounds for allotments of prizes, whilst they have power to seek the aid of a specialist, if necessary, in furtherance of investigation To be qualified for election on a Nobel Committee it is not essential to be a Swedish subject

During the course of the month of September in each year the Nobel Committees are empowered to issue a circular to all those who are qualified, asking for nominations of candidates for prizes before the first day of February in the following year, such nominations to be supported by evidence, documentary and otherwise It is essential that only duly qualified persons propose candidates A direct application for a prize is not taken into consideration

1 *Physics and Chemistry Sections* The right to hand in the name of a candidate appertains to

(a) Home and foreign members of the Royal Academy of Science, Stockholm

(b) Members of the Nobel Committees of the Physical and Chemical Sections

(c) Men of science who have received a Nobel prize from the Academy

(d) Professors of the physical and chemical sciences of the Universities of Uppsala, Lund, Oslo, Copenhagen, and Helsingfors, at the Caroline Institute, Stockholm, and the Royal Technical College, Stockholm, and also those teachers of the same subjects who are on the permanent staff of the Stockholm University College

(e) Holders of similar chairs at other universities or university colleges, to the number of at least six, to be elected by the Academy of Science in the way most appropriate for the just representation of the various countries and their respective seats of learning

(f) Other men of science whom the Academy of Science may see fit to select

The members of the present Committee for Physics are—

Prof Carl W Oseen (Uppsala)
Prof V Carlheim Gyllensköld (Stockholm)
Prof Karl M G Siegbahn (Uppsala—Nobel prize, 1925)
Prof Henning B M Pleijel (Stockholm)
Prof Erik W Hulthén (Stockholm)

The members of the present Committee for Chemistry are—

Prof Henrik G Soderbaum (Stockholm)
Prof Theodor Svedberg (Uppsala—Nobel prize, 1926)
Prof Knut W Palmaer (Stockholm)
Prof Ludwig Ramberg (Uppsala)
Prof Hans Karl von Euler-Chelpin (Stockholm—Nobel prize, 1929)

Secretary to the above Committees—

Prof Arne Fredrik Westgren (Stockholm)

2 *Physiology and Medicine Section* The qualification for the right to nominate candidates is possessed by

(a) Members of the professorial staff, Caroline Institute, Stockholm

(b) Members of the medical class of the Royal Academy of Science, Stockholm

(c) Nobel prize-winners in the section

(d) Members of the medical faculties of the universities of Uppsala, Lund, Oslo, Copenhagen, and Helsingfors

(e) Members of at least six other medical faculties, to be selected by the staff of the Caroline Institute in the way most appropriate for the just representation of the various countries and their respective seats of learning

(f) Men of science whom the above staff may see fit to select

The Nobel Committee of the section shall hand in its verdict and proposals for the prize award to the professorial staff of the Caroline Institute within the month of September

The members of the present Committee for Physiology and Medicine are—

Prof Gunnar Hedrén (Stockholm)
Dr Hans Christian Jacobæus (Stockholm)
Dr Hans Valdemar Gertz (Stockholm)
Dr Einar Hammarsten (Stockholm)

Secretary to the Committee—

Dr Goran Liljestrand (Stockholm)

Special Funds of the Sections

The Statutes provide, within strictly defined limitations, for the establishment of Special Funds for each of the five sections of the Noble Foundation The proceeds of any and every such fund may be employed, subject to the approval of the adjudicators concerned, to promote the objects which the testator ultimately had in view in making his bequest, *in other ways than by means of prizes* In the domain of physical and chemical science, support in furtherance is consequently available, if judged to be of significance either in a scientific or a practical regard Proposals for the awarding of assistance of this nature remain with the respective Nobel Committees Similarly, such proceeds may be devoted to promoting research in medical science, and in rendering the results of that research of practical use to mankind In this section a proposition may be made by a member either of the staff of the Caroline Institute, or of the Nobel Committee

Obituary

THE RIGHT HON THE EARL OF BALFOUR, K G, O M, F R S

THE genuine statesman, so we read in the *Republic*, will be the man who, in contemplating the true good, makes it a pattern for ordering the State and individuals and his own conduct, who spends much of his time in philosophic reflection, and yet, when his turn comes, endures for the sake of the public welfare the toil of politics and ruling, not as though he were performing some meritorious deed but simply as a matter of duty In writing of the great personality lost to the nation on Mar 19 last, one can scarcely avoid recalling the well-known portraiture. For, if ever in the chequered course of human history Plato's ideal has been to some extent realised, it was in Lord Balfour's case Other political leaders have been classical scholars, men of letters, and even men of science Who, however, among Prime Ministers, has ever before not only made philosophy his main pursuit as an undergraduate, but also at the age of thirty published in a technical journal an elaborate criticism of the transcendental theory of knowledge of sufficient importance to elicit replies from such eminent Kantian scholars as Edward Caird and John Watson? And, needless to add, this was the outcome not merely of a passing phase in the career of a distinguished public man, it was the prelude to a large number of subsequent efforts in the field of speculative thinking, interest in which was no less keen in the man of eighty than in the man of thirty

Arthur Balfour came to Cambridge from Eton in

1866, and at once fell under the spell of Henry Sidgwick, his senior by about ten years Of Sidgwick it has been said "he did not teach as a prophet, and he required of his pupils hard thought, without promising them that this would result in any revelation of the secret of the universe", and Balfour himself wrote of him that "he never claimed authority, he never sought to impose his views, he never argued for victory, he never evaded an issue" That the pupil who was destined soon to become a warm personal friend was immensely influenced by his teacher there can be no doubt In all Balfour's published work, characterised, indeed, by an ease and beauty of style and a wealth of epigram to which Sidgwick's can lay no claim, there is to be traced that critical habit of mind, that evenly balanced judgment, and that distrust of dogmatic systematising which, in his undergraduate years, he had seen so uniquely exemplified In the year 1869, he took the Moral Sciences Tripos, one of the first to be examined under the new scheme, with the framing of which Sidgwick had been closely concerned

Ten years intervened between his taking the degree and the appearance in 1879 of Balfour's first book, "A Defence of Philosophic Doubt", although he had previously published several philosophical articles in *Mind* and elsewhere, and meanwhile he had entered the House of Commons as member for Hertford Fourteen more years elapsed before his second book, "The Foundations of Belief", saw the light in 1895, but, again, during the interval numerous articles of his had appeared in periodicals, amongst them a delightful essay on Berkeley, and two Lord Rector's addresses had been delivered, one at St Andrews in 1887, and the other at Glasgow in 1891 Then followed in 1915 the first volume of Gifford Lectures on "Theism and Humanism", delivered in Glasgow just prior to the outbreak of the War, and which he managed to prepare for the press before joining the Coalition Cabinet, and finally, in 1923, there appeared the further volume on "Theism and Thought", containing the second series of Glasgow lectures, delivered in 1922–23, when the author was more than seventy-four years of age Many smaller things ought to be mentioned, especially the striking presidential address to the British Association at the Cambridge meeting of 1904 It is an extraordinary record of independent and vigorous intellectual activity on the part of a man who was never free from the strenuous demands of political life, and was fulfilling various functions in the educational world and in many other spheres "Literary composition", he once said, "I have always found laborious and slow, even in favourable conditions" Yet whatever he wrote is remarkable for its fresh, lucid, and graceful mode of expression, as Sir Frederick Pollock put it in 1895, he will have done much to bring back the good days of Berkeley and Hume when philosophy could speak English.

At the time when Balfour's first book was written, the dominating philosophical influences in England, both at the universities and perhaps more decidedly among the philosophically minded outside the universities, were J S Mill and Herbert Spencer—Mill more than Spencer, although it is true that in Oxford and Glasgow German idealism had powerful representatives The philosophic doubt which Balfour defended was doubt as to the legitimacy of either of these ways of handling ultimate problems In dealing with the former, which had culminated in an agnosticism the cardinal tenet of which was that knowledge is confined to phenomena and the laws of phenomena, he directed attention not upon what was alleged to be unknowable but upon what was alleged to be known If we are to believe nothing but what we can prove, let us see, he urged, what it is that we *can* prove He started by emphasising as fundamental the distinction between the causes or antecedents which produce a belief and the grounds or reasons which justify one,—a distinction which every competent thinker would acknowledge as vital now, but which was constantly being lost sight of then Confining himself to logical grounds or reasons, Balfour tried to show, and certainly succeeded in showing, that, on the basis of an empirical theory such as was then current, the premises on which the system of modern science rests can neither be proved nor rendered even probable

A philosophy which is to justify the procedure of science must be prepared to give a coherent account of two radical beliefs at least—the belief in the uniformity of Nature and the belief in a world of physical things existing independently of the individual mind that is apprehensive of them, and of neither could the current empiricism give a coherent account As regards belief in an external world, Mill's doctrine of 'permanent possibilities of sensation' and Spencer's doctrine of 'transfigured realism' fell easy preys to Balfour's incisive dialect Neither could afford the slightest warrant for asserting the existence of a material universe the objects of which are composed of atoms and molecules, vibrating with different degrees of rapidity, and in which modes of energy are everywhere operative Spencer had himself admitted that if the theory of subjectivism were right the doctrine of evolution would be a dream, but the arguments which he brought to bear against what he called 'crude realism'—the "realism of the child and the rustic"—involved him in the very subjectivism he had attributed to the 'unimaginable blindness' of the 'metaphysicians' As regards the uniformity of Nature, Balfour argued that not only is the statement of it as an inference from particulars 'by simple enumeration' incapable of proof, but that, when so interpreted, it cannot be thrown into any accurate form save at the expense of making it unmeaning In dealing with transcendentalism, he maintained that, so far as causality is concerned, all that Kant, even on the most favourable view of his reasoning, can be said to have established is that the totality of phenomena at one instant is the effect of the totality of phenomena at the previous instant,—a general proposition which by itself is wholly inadequate to serve as a basis for scientific induction For this general proposition might be quite true, and yet the course of Nature might be,

to all intents and purposes, absolutely irregular, unless a fixed relation subsist not merely between the totality of phenomena but likewise between extremely small portions of that totality, and not merely between individual concrete phenomena but between classes of phenomena

The argument of the early work was, it is true, conducted with an *arrière pensée* in the shape of 'practical results' it was taken to yield, so far as a theistic view of the world is concerned But, in his second book, Balfour attempted to develop the negative speculations of philosophic doubt into a constructive, if provisional, system of thought As before, he proceeded by criticising what he here designates 'naturalism', meaning by that term virtually a purely mechanical theory of Nature, which "forces itself into the retinue of science", and "claims, as a kind of poor relation, to speak with her voice" With singular effectiveness, he sought to bring into the foreground the implications, in the spheres of ethics, æsthetics, and of rational thought generally, which this doctrine entails In the first place, the consciousness of freedom, the sense of responsibility, the authority of conscience,—these, along with the train of beliefs and sentiments from which virtuous deeds and generous ambitions spring, evince themselves as mere devices for securing certain competitive advantages in the struggle for existence In the second place, the persistent endeavours of æsthetic theory to show that the beautiful is a necessary and unchanging element in the general scheme of things indicate, at any rate, that mankind will not be easily reconciled to the view that beauty is but the chance occasion of a passing pleasure, and that, so far from disclosing hidden mysteries to us, poets and artists portray what, though it may be very agreeable, is seldom true and never important "We cannot willingly assent to a theory which makes a good composer only differ from a good cook in that he deals in more complicated relations, moves in a wider circle of associations, and arouses our feelings through a different sense" In the third place, human reason, so far from being Nature's final product, is, according to the doctrine in question, no more than one of many expedients for increasing our chance of survival, and which, we may suppose, will be gradually superseded by the growth of instincts or inherited habits, by which such adjustments between the organism and its environment as now seem dependent on it will be more successfully effected

Having thus exhibited the inherently irrational character of the naturalistic theory, Balfour attempted to sketch in outline a philosophic position which, while admittedly incomplete and suffering from gaps and rents, from loose ends and ragged edges, would yet do justice to the fact that in accepting science, as we all do, we are moved not merely by strictly logical considerations but also essentially by 'values' A fearless examination of the grounds on which judgments about the physical world are founded will disclose, he argued, that they rest on postulates about which it is equally impossible to say that we can theoretically regard them as self-evident, or practically treat them as doubtful We can neither prove them nor can we give them up Grant the same philosophic weight to values in those departments of speculation that look beyond the physical world, and naturalism will have to be abandoned once for all The vast majority of our beliefs, of our ethical, social, and religious beliefs especially, have not been attained by any process of logical reasoning, they have been generated in us by custom, education, public opinion, by the contagious convictions of countrymen, family, and so on, and, not least, by "the 'spirit of the age', producing a certain psychological 'atmosphere' or 'climate' favourable to the life of certain modes of belief, unfavourable, and even fatal, to the life of others" Unfortunately Balfour used the misleading and inappropriate term 'authority' by which to denote the group of influences thus enumerated But, as a discerning German critic has observed, what he really meant "may all be covered by the proposition that we men, in our higher spiritual life, are the products of history before we are its producers, and that in this double relation of ours to history the weight is permanently to be placed upon our dependence on the historical factors which surround and determine us" And it is, I take it, certain that, although he not seldom contrasted what he called 'authority' with reason, Balfour did not mean to imply that, in the last resort, the beliefs in question are 'irrational' On the contrary, he insisted that we are driven to believe in a supreme Reason, in order to account for the presence of these factors in the human world at all The presupposition that the world is "the work of a rational Being, who made *it* intelligible, and at the same time made *us*, in however feeble a fashion, able to understand it" is a presupposition "forced upon us by the single assumption that science is not an illusion"

I must not dwell upon Lord Balfour's further elaboration of these principles in the Gifford Lectures Those of us who have been privileged to take part with him in philosophical discussion need not to be reminded of his invariable fairness and patience in listening to views that were opposed to his own, or of his wonderful power of quickly seizing the main points in a complicated argument, and of freeing it from irrelevancies Nowhere will his presence be more sincerely missed than in the small gatherings of philosophic workers, where he was always so much at home

G DAWES HICKS

From Sir J J THOMSON, O M, F R S,
Master of Trinity College, Cambridge

IT may fairly be said of Lord Balfour that no statesman ever did so much to promote the development of science or kept in closer touch with its progress He was First Lord of the Treasury during the initial stages which led to the foundation of the National Physical Laboratory, and it was his sympathy and support which made the Laboratory possible He was instrumental in founding the Department of Scientific and Industrial Research,

and was, as Lord President of the Council, for many years its official head Everyone who has been connected with the Department knows the keen interest he took in its work and development and how much it owes to his advice and sympathy, on which they felt they could rely in any case of difficulty help was never given more gracefully or more tactfully The same is true of the Medical Research Council, in which he took deep interest

Lord Balfour was one of the pioneers in advocating the application of research to industry In the Sidgwick Memorial Lecture for 1908 he said of it "That on this we must rely for the improvement of the material conditions under which societies live is in my opinion obvious, though no one would conjecture it from a historic survey of political controversy" It was not only in industry that he recognised the importance of science, for in the same lecture he said "Science is the great instrument of social change, all the greater because its object is not change but knowledge, and its silent appropriation of this dominant function amid the din of political and religious strife is the most vital of all the revolutions which have marked the development of modern civilisation"

A liking and aptitude for science were in Lord Balfour's blood His uncle, the late Marquis of Salisbury, was distinguished among statesmen by his interest in science, and was president of the British Association at the famous meeting at Oxford when Lord Rayleigh and Sir William Ramsay announced the discovery of argon Lord Balfour's brother, Frank Balfour, before he was thirty, was the most distinguished morphologist in Great Britain, and his tragic death when he was but thirty one affected Cambridge more deeply than any event I can remember

Apart from his interest in science as a social and industrial force, Lord Balfour took a keen interest in it from the philosophical side and kept in close touch with modern developments He had been a fellow of the Royal Society since 1888 and had served twice on its Council, he was president of the British Association at the Cambridge meeting in 1904, and gave a very characteristic address which showed a close acquaintance with the new views about the nature of matter and was illuminated by witty and weighty criticisms of their philosophic aspect Conversation on scientific subjects with Lord Balfour was an intellectual tonic he was so quick in seizing the points, in picking out those which were vital, and in foreseeing possible developments

In 1919, Lord Balfour succeeded Lord Rayleigh as Chancellor of the University of Cambridge, and was most active and helpful in securing the means for the erection of a new library for the University, the most important event in its recent history He had previously been instrumental in securing a new professorship—the Arthur Balfour professorship of genetics A short paper he wrote in 1910 induced an anonymous benefactor to offer to found the professorship provided it was associated with the name of Arthur Balfour His connexion with Trinity College was long and intimate he had been a member of the College for sixty-four years and an honorary fellow for forty-two two brothers, Gerald and Frank, and two brothers-in-law, Lord Rayleigh and Henry Sidgwick, were fellows of the College and took an especially active part in its work, and the connexion, much prized by the College, has been continued in the younger generations of his family

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From Sir Alfred Ewing, K C B, F R S, lately Principal and Vice Chancellor of the University of Edinburgh

I have been asked to write a note about Lord Balfour's association with universities, perhaps because I served under him as Vice-Chancellor in one of them for thirteen years Perhaps also because a previous service under him at the Admiralty, when he was First Lord during the War, had created a personal link which the subsequent intercourse maintained and strengthened Meeting Lord Balfour from time to time in the serene yet vigorous evening of his life, one found in him continually more and more to admire and revere and love

Lord Balfour's connexion with universities is too big a subject for a brief note He was Chancellor of two—Edinburgh for thirty nine years and Cambridge for eleven He was honorary doctor of at least sixteen, rector of two, a member of the senate of another He had been Gifford lecturer, Romanes lecturer, and so on Such points of established contact meant much to the universities concerned His immense influence and authority could be invoked, his advice could be sought, his sympathetic comprehension of university affairs never failed It was for such reasons that he undertook, in his double capacity as Chancellor of Cambridge and of Edinburgh, to lay the case for the universities before the Treasury, thereby securing a much-needed increase in the annual grants

To Balfour himself the academic atmosphere was congenial He was conspicuously a fine flower of university culture He understood the ways and aims of universities, their potentialities and their difficulties In many addresses he spoke of them with insight and affection He praised their past, noting especially how they had served as disinterested pioneers in scientific research He had confidence in their future But he was acutely alive to the need of adaptation to altering conditions He saw that the promotion of research had become a public duty, to be undertaken on a scale larger than they could handle and needing greater resources Fortunately, it fell to him, as Lord President of the Council, to direct the development of scientific and industrial research as a national task

Through his membership of Trinity, his brothers' fellowships there, the tenure of the Cavendish chair and, later, the Chancellorship by his brother-in-law, the late Lord Rayleigh, and the appointment of his sister, Mrs Sidgwick, to be head of Newnham, he had many ties with Cambridge When he was asked to become Chancellor, he had already for a long time held the like office at Edinburgh, and it was typical of his courtesy that before accepting the

Cambridge invitation he consulted Edinburgh opinion as to whether there might be objection to his holding both He was quickly reassured, and certainly neither University was prejudiced by his association with the other

With Edinburgh Balfour had a geographical connexion, for his ancestral home was not far off When in residence at Whittingehame, it was easy for him to come to us His visits were not infrequent, especially after the claims of political life had grown less insistent Some occasions were ceremonial, others more private, and these he unaffectedly enjoyed I recall his presiding when the Prince of Wales opened a new building and received an honorary degree The Prince, duly 'capped', was called upon to speak, and to the delight of a vast concourse of undergraduates proceeded thus to chaff the Chancellor

This is by no means the first time, Mr Chancellor, that we have met one another in circumstances such as these You will doubtless recall a day at Cambridge when you were good enough to confer a degree upon me in Latin, a language with which, I regret to say, I am unable to claim great familiarity Shortly afterwards I found myself in a position, as Chancellor of the University of Wales, to retaliate, when in admitting you to a degree at Cardiff it fell to my lot to address you at some length in Welsh Now, for the third time, with no handicap on one side or the other, we meet in a common tongue, and the match, if I may put it so, remains all square

Another notable occasion was the rectorial address of Mr Baldwin, then Prime Minister A bad tradition among Scottish students had made the address of the rector an opportunity for a 'rag' In pre-War days the Chancellor had suffered from this exuberance to an extent that strained even his good-nature When I asked him to come he stipulated that this time there should be reasonable order Accordingly I summoned the leaders of the students' unionist, liberal, and labour associations, the president of the athletic club, and one or two more, and showed them Lord Balfour's letter They declared with one voice that in his presence order must be and would be kept Sinking political differences they wrote a 'round robin' begging him to trust them and come He did, and was gratified to find them as good as their word The suppressive measures were their own, if drastic, they were completely successful It was the dawn of a new era

An example of a less formal visit was when Balfour came to talk to the students of history about the London Conference on Imperial Relations, and deftly countered an invited fire of questions Another was when he presided at the first of Prof Eddington's Gifford Lectures Such contacts were, I think, as agreeable to him as to us His greatness, his maturity, his detachment from the commonplace, were no bar to intercourse He would charm those he met into giving him of their best To some he would talk philosophy, to others music, to others medicine, to others the bewildering developments of modern physics There his bent towards science as well as philosophy found a double interest He rejoiced in the escape of scientific thought from the crude materialism which was vocal fifty years ago He followed the kaleidoscopic changes of atomic theory with an alertness that was the envy of younger men

My last meeting with him has left a happy memory It was on the day in July 1928 when, in honour of his eightieth birthday, he was entertained by the British Academy At the luncheon he had been in great form, clearly delighted with the tribute and moved by it That summer evening I met him again, sauntering hatless near his house, genial, buoyant, radiant It was hard to believe he had eighty years behind him Those whom the gods love die young of that company was Balfour

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From SIR FRANK HEATH, G B E , K C B , formerly Secretary, Department of Scientific and Industrial Research

LORD BALFOUR was twice Lord President of the Council, first from October 1919 until the fall of the Coalition Government in October 1922, and again in 1925 on the death of Lord Curzon until the end of that Parliament in the spring of 1929 The Lord Presidency used to be considered a general utility office He converted it into a Ministry of Research The idea was not born in his fertile brain, for a Committee of the Privy Council for Scientific and Industrial Research and a similar Committee for Medical Research had been established during the War, and Lord Haldane's Committee on the Machinery of Government had recommended the creation of such a Ministry But Lord Balfour it was who turned an experiment which many thought destined to disappear with other War time devices into a reality which is now generally recognised as a permanent and essential part of modern government His unparalleled prestige in the political and intellectual worlds, his liberation from the rough-and-tumble of party politics, were favourable circumstances, but his abiding faith in the power of science to promote the happiness and well-being of man, his enthusiastic interest in the advance of knowledge, his sympathy with the scientific outlook and with young people, and his long experience of the way in which things have to be done in Great Britain, were the decisive factors

He was constantly called away during his first Lord Presidency by urgent Imperial affairs, to the Foreign Office when Lord Curzon was abroad, to Geneva in the first critical months of the League of Nations, to the United States for the first and so far the only international conference that has led to disarmament, but he found time in 1921 to lay the first foundations of a comprehensive structure destined ultimately to bring the whole national administration within the range of scientific influence He was chairman of a Cabinet committee appointed to study and report on the co ordination of the scientific work of all Government departments The need for economy had been the theme of discussion, and this was his way of meeting it Even to outline the findings of that Committee is impossible here, but it led to a gradual and decisive rationalisation of the research work done by the Admiralty, War

Office, and Air Ministry, of research for defence and for industry, of civilian and military research in medicine, of research in forestry and forest products, that has saved Great Britain untold expenditure and has brought an inestimable increase in efficiency

During his second term of office in a post once thought of as full of dignity and leisure, Lord Balfour devoted the larger part of his many-sided interests, and ungrudgingly of his time, to the continuance of this work He became chairman of the Medical Research Council and constantly attended the meetings of the Advisory Council for Scientific and Industrial Research, the bodies responsible for making recommendations to the Lord President as to the expenditure of the funds voted by Parliament for research in their respective fields He felt no embarrassment in this dual position, for the differentiation of function between the organs of scientific and administrative advice seemed to him natural and inevitable, provided they were properly integrated at the point of decision This integration the constitution of the two new departments of medical and industrial research had for the first time successfully achieved He always believed, and he hoped to the end, that a similar organisation for research in agriculture would complete the circle and so link together the services of science for the health and all the productive activities of man His chairmanship of the Research Committee of the Imperial Conference in 1926, followed by the Imperial Agricultural Research Conference in 1927 brought the realisation of this hope definitely nearer and led to most important advances in the co-ordination of agricultural research throughout the Empire

Lord Balfour realised, however, that the completed picture must include even more than this His first act on resuming office in 1925 was to consider a memorandum handed to him by Mr Baldwin, which led his critical, constructive, and experienced mind to formulate a plan for establishing on the lines of the Imperial Defence Committee—itself an earlier creation of his—a Cabinet Committee for Civil Research of which he was chairman until 1929 The object of this committee was to provide a permanent and flexible organisation which, by working through temporary sub-committees of experts specially appointed for the purpose, might study, and help the Government to solve, problems which crossed the bounds of single departments, or even those of England as a single member of the Imperial Commonwealth By this means co-ordination was secured in dealing either with general problems of organisation, or with specific questions such as sleeping sickness, the possibilities of geophysical survey, the scientific exploration of the Great Barrier Reef, or the restriction of rubber production The best brains within and outside Government departments were brought into council, without advertisement or the incubus of a published report, and incidentally the inevitable tendency to departmentalism was mitigated The present Government has altered the name of the committee and has added an Advisory Economic Council in more or less permanent session, with what results time alone will show, but Lord Balfour's plan will, it may be hoped, be understood and maintained

It is at first sight unexpected that a mind so detached as Lord Balfour's, so philosophic in its outlook, so critical and even sceptical in its methods, should have shown this constructive genius But if we remember, on one hand, the "Foundations of Belief" and on the other, the great Education Acts of 1902 and 1903, the riddle is plain His criticisms, often put as a question, forced his councils and his officers to think clearly, his sympathy with their hopes and difficulties won their devotion, his understanding of the scientific mind their confidence, his courage in decision when they sometimes hesitated to commit themselves their respectful admiration Often would he illuminate an intricate problem with a phrase which would simplify and clarify its complexities Such a phrase occurs in the preface he wrote to the classical study of moving loads on bridges, the outcome of four years' work by the Bridge Stress Committee of the Department of Scientific and Industrial Research "Fixed bridges and trains in motion become for brief periods parts of a single mechanical system" There stood the problem in crystalline clearness, and clear as crystal is the mind that has left us

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By H T Tizard, F R S, Rector of Imperial College of Science and Technology, formerly Secretary of the Department of Scientific and Industrial Research

Lord Balfour held throughout his life a firm belief in the material as well as in the intellectual value of scientific knowledge He lived to see his views shared by most public men Largely through his influence, there has been brought about a complete change in the attitude of Parliament towards scientific matters, and the encouragement of research is now considered an essential duty of Government Lord Balfour gradually and inevitably became the man to whom his political colleagues, and many of his political opponents, naturally turned to keep them in touch with scientific developments It was remarkable how he managed to do it, busy man as he was It is hard enough for the scientific worker to keep abreast of modern progress, and one would have thought it almost impossible for a man so fully occupied with other affairs Lord Balfour succeeded partly by reading—one could usually find Nature and a modern scientific book on the little table by his chair—but mainly through meeting and talking to the leaders of scientific thought of the day, for whom he had a profound admiration

Lord Balfour took an intense interest in the Department of Scientific and Industrial Research, and found time to exert an inspiring influence on its work He never seemed to dictate policy or to interfere with executive matters he preferred to give the utmost freedom of action to his officers and to his distinguished Advisory Council, and yet, somehow, he dominated us all. If a new proposal was submitted to him he received it always with

interest, and often with enthusiasm He liked to talk about it, not to read about it, he found formal memoranda tedious! In conversation he would probe its weak points, and illuminate its good points, always sending one away with something more to think about, some fresh orientation of ideas

He felt doubtful about the wisdom of making grants to universities for specific researches, holding the principle that any grants given by the State to universities should be given for general purposes and not for specific objects He was more strongly opposed to the Department undertaking research at the cost of the State in the interests of particular manufacturing industries The argument that the particular industry was not doing enough, and that the work was necessary in the interests of the country, did not fundamentally appeal to him, for he held, broadly, that if British industry could not or would not adopt scientific methods, nothing that the State could do would save it This is not to say that he definitely refused to sanction such work, but he wished that whatever was done was limited in scale and was intended rather as an example of what might be, than as a substitute for what should be, undertaken by industry On the other hand, any research in the general interests of industry or of the community had his whole-hearted support, one might instance a comparatively recent development, namely, that of research into the cause and prevention of the pollution of rivers, as the kind of thing that interested him, and in which he thoroughly believed

In his somewhat infrequent visits to research stations—too infrequent for his and our liking—Lord Balfour's acuteness of observation often surprised me Those who knew him will probably think the word 'surprised' out of place I use it because, with my fairly extensive experience of distinguished visitors to research stations, I cannot recall anyone who excelled him in accuracy of appreciation and criticism after a single visit To his staff he was courtesy itself, and he was repaid by loyal and affectionate service Like all really great men, he treated them as equals need it be added that he knew how to get the best out of men ?

News and Views

THE Prince of Wales has promised to visit University College, Cardiff, on May 21, for the purpose of opening the new laboratories of physics and chemistry, which together form the north wing of the new buildings in Cathays Park, the civic centre of the city The group of public buildings in this quarter form an *ensemble* which is said to be unique in Great Britain To keep an honourable place in such an architectural constellation has taxed the resources of the College heavily, but the result of the effort has been duly gratifying Altogether, the cost of the new wing amounts to £220,000, of which some £15,000 is still outstanding It comprises laboratory accommodation of the most modern type and on a scale suitable to the needs of the large population of the district The Council of the College having recognised that advances in technology are essential to the welfare of South Wales and that such advances can only rest on a basis of research in physics and chemistry, these two departments were given priority in the programme of development The completion of this stage will, it is hoped, clear the way for further advances The Prince of Wales will also inspect the new Advisory Department of Agriculture, which forms an addition to the south side of the College buildings

WIDE interest is being taken in the forthcoming Wedgwood bicentenary celebrations which are to be held on May 19–24 at Stoke-on-Trent Their object is to commemorate the birth of Josiah Wedgwood (1730–1795), the great pioneer potter His systematic methods and scientific outlook were unique amongst the potters of his own day, and still command the highest respect The celebrations will be under the patronage of H M The Queen, whose sustained interest in the potteries and British pottery craftsmanship is well known, Princess Mary is to pay a visit to the Potteries during the celebrations A large influx of visitors is expected from all parts of the country and abroad, and the whole city will be in festive mood A historical pageant of eight episodes illustrating the history of the district from the days of the early Britons up to the modern industrial developments of the city will be produced daily by some 5000 performers reinforced by massed orchestras and choirs A military tattoo and torchlight spectacle, a tableau by 1500 pottery workers, physical training displays by 3000 school children, concerts, a fancy dress ball, and other items will cater for the interest and amusement of the general public

DURING the week of the Wedgwood celebrations the Ceramic Society, the object of which is the technical advancement of the pottery and other branches of the clay industries, will be the host of a large number of visitors representing kindred societies in Great Britain, the United States of America, Canada, France, Germany, Japan, Italy, Holland, Sweden, and Poland The Society and visitors will be received by the Lord Mayor and Lady Mayoress of Stoke-on Trent and entertained to luncheon Numerous other functions are also being arranged for the three days, May 21–23, set aside for the Society's celebrations These include a special visit to Wedgwood's works, when the party will be entertained to luncheon by Major Wedgwood, the present head of the works and a direct descendant of the great Josiah Wedgwood The Ceramic Society is also holding technical meetings, for which a large number of papers has been promised, and is offering prizes for the best essays on "The Contributions of Josiah Wedgwood to the Technical Side of the Pottery Industry" A special commemorative volume is also being published by the Society. Extensive exhibitions of modern

and historic pottery, amongst which will be certain pieces loaned by the Queen, will also be important features of the week

The Fifth International Botanical Congress is to be held at Cambridge on Aug 16–23 next In this connexion a circular has been issued on behalf of the Imperial Forestry Institute at Oxford, the Yale School of Forestry, and the Forest Products Research Laboratory, Princes Risborough, in which it is suggested that an informal conference on the systematic anatomy of wood should be conducted It is pointed out that this subject is rapidly increasing in importance, and more especially in the identification of timber "The numerous anatomical descriptions of timbers", state the authors of the circular, "which have been published of recent years, direct attention to the lack of any standard terminology, and it is thought that the Congress will provide a unique opportunity for discussing the possibility of introducing some measure of standardisation, at least among English-speaking people" There is little doubt on the subject of the confusion at present existing in this matter It will not be the first effort made to deal with it, but the present one has the advantage of being better planned It is also hoped to arrange a scheme for the exchange of material among botanists and forest botanists who are willing to undertake the study of a family or group Finally, the authors of the circular state that they are desirous of obtaining the views and co-operation of as many as possible of those who are interested in this subject They therefore invite suggestions of matter for discussion both from botanists who propose to attend the Congress and from those who will be unable to do so The suggested conference, should it receive adequate support, may be expected to achieve results of real practical importance to the forester, botanist, and timber merchant

The Royal Society for the Protection of Birds has issued an appeal for £4000 to purchase the site of a proposed permanent sanctuary for wild fowl in Romney Marsh A nucleus of eighteen acres has been in the hands of the Society for some time, and there is now an opportunity of completing the scheme The site consists of grassland, reed beds, mud banks, and open water it is far from roads and is made still more inaccessible by wide intersecting ditches The description suggests that the place is an exceedingly favourable one for the protection of the bird visitors, particularly ducks and waders, for which this part of Kent is well known The scheme has novelty for Great Britain in that the sanctuary will probably be more important as a reserve for wintering birds and resting migrants than as a breeding haunt That there is need of such reserves was shown by the report of the international conference on the protection of migratory wild fowl, held in London in 1927, and it is much to be hoped that the present proposal will be well supported

The Symons Memorial Lecture for 1930 of the Royal Meteorological Society was delivered on Mar 19 by Dr Herbert Lapworth, who took as his subject "Meteorology and Water Supply". Dr Lapworth dealt mainly with the story of the rain between its precipitation as rainfall on the surface of the ground and its later appearance in the form of streams, springs, and underground water, that is to say, a brief outline of the sciences of hydrology and hydrogeology as bearing upon the preliminary investigation of the water engineer Precision in water-supply problems can only be obtained by the collection of data in these two sciences and in rainfall statistics Water-engineers start from the basis of rainfall, the laws of fluctuation of which are regarded as more precise than the laws of hydrology and hydrogeology The preliminary investigations of water supply, however, are based upon nineteenth century rainfall observations, whereas there is good evidence that in the previous century there were longer and worse droughts than those which occurred within the next hundred years If such conditions recurred probably no waterworks in Britain could adequately meet them After discussing the driest years, on which basis waterworks were designed, Dr Lapworth dealt with floods and stream flow in general, reviewing the relation between rainfall and run off and the losses due to evaporation and other causes in streams and underground water The movement of underground water, the formation of springs, and the fluctuation of water level were described, and references made to bournes and disappearing streams The question of wells and the effects of pumping were discussed and the artesian basins of the world were briefly noted, illustrating the immense distances travelled by underground water

In his Friday evening discourse on Mar 21 at the Royal Institution on "Sea Birds and Seals", Mr Seton Gordon described the seals and birds found on the Atlantic coast of Britain The gannet is the largest and strongest flier of British sea birds In summer, from August until the second week in October, they are to be seen passing north and east, past Rudha Hunish, the most northerly point of the Isle of Skye Most of the gannets may be seen later on flying back to St Kilda This is ninety miles west of Skye, and is their nearest nesting haunt to that island, so these gannets make (including the double flight) a journey of 200 miles each time they fish on the coast of Skye A gannet has a great aversion to land Thus all the gannets of St Kilda which fish in the Minch towards its northern part all make for the Sound of Harris opening When they fly homeward, heavy laden with fish, they fly only a few inches above the sea; in large parties the numbers are almost always uneven It is a remarkable thing that the gannets find their way home to St Kilda through mist and fog, often when there is a strong side wind blowing The stormy petrel is smallest of British sea birds, it is only 6 inches long It was named petrel or 'peter el' (little peter) because it was believed that, like Saint Peter, it was able to walk upon the water The stormy petrel is a nocturnal bird That is why sailors count it unlucky to see a stormy petrel in daylight It is only on very dark days (and dark days usually presage a storm) that the stormy petrel is abroad, on fine days it sleeps at

sea Mr Seton Gordon also showed a film of the Atlantic seal, probably the first which has been taken of these animals on their island In October all the Atlantic seals of a wide district go to a lonely isolated isle where they have their young There may be 200 young seals on one of these islands For the first six weeks young Atlantic seals are land animals, during all this time they do not enter the water of their own accord

AT their meeting on Mar 22, the Trustees of the British Museum approved the purchase for the Department of Zoology of the very extensive and valuable collection of skeletons of mammals, birds, reptiles, and fishes formed by the late Mr E T Newton A particularly valuable section is Mr Newton's series of the otoliths or ear bones of fishes, these are often the only remains of fishes found in a fossil condition, and the collection has frequently enabled geologists to determine remains that would otherwise have been quite unrecognisable The collection will be available for study and research only Recent acquisitions in the Department of Geology include British fossils bequeathed by the late Mr G W Young, and others purchased from the collection of the late Mr E T Newton, the most important of the latter are a series of Pliocene mollusca from the St Erth beds, Cornwall These beds are two small patches remarkable for being the only known English beds of Pliocene age lying west of Kent and East Anglia The fossils occur in clay underlying sand and gravel, and unless this clay is opened up for some special reason, the fossils are unobtainable H M the King has placed on loan in the Department of Botany 267 specimens of dried plants from Nepal The collection is of special value in the Museum because of the lack of material from Nepal, only a very small area of which has been explored botanically The large and valuable herbarium of the late Mr C E Salmon has been bequeathed to the Department Mr Salmon was an authority on certain genera and on the distribution of British plants, and at his death he had almost completed a flora of Surrey The European Herbarium has been further enriched by the purchase of the herbarium of the late A A do Carvalho Monteiro This consists of about 4500 sheets and provides a good series of Portuguese plants

THE importance of the medical and surgical applications of electricity can scarcely be overestimated If we assume that the importance of any sphere of activity is reflected in the literature which arises regarding it, then Great Britain is very backward compared with other countries In Germany there are seven journals exclusively devoted to radiology, in the United States six, in France five, in Italy four, and in Britain one In a paper read to the Institution of Electrical Engineers on Mar 20, Dr Leggett pointed out that medical research would greatly benefit by an improved engineering finish being given to electro-medical apparatus Much of this comes from abroad, where there is a large home demand for it Foreign manufacturers are, therefore, in a better position to supply cheap apparatus than the British manufacturer who has to compete with them There are firms for manufacturing medical apparatus in the United States, Germany, and France which, individually, are larger than the whole British industry for this class of goods put together Since the late Mr Campbell Swinton first used X ray tubes in Great Britain, revolutionary improvements in their manufacture have taken place Although the electron tube has many advantages, yet, as until recently its price was nearly £40, it is little used Its price is now £25, but as in Germany one can be purchased for £9 there is a great scope for reduction in price It is gratifying to find that England has taken the foremost place in protective measures against the disease which attacked many of the early operators They form the basis of the international protective measures adopted at Stockholm in 1928

MR CHARLES HASKINS TOWNSEND, Director of the New York Aquarium, has published a most interesting account of his aquarium and the management of aquaria in general ("The Public Aquarium its Construction, Equipment, and Management" Department of Commerce, Bureau of Fisheries, Appendix 7 to the Report of the U S Commission of Fisheries for 1928 Bureau of Fisheries Document No 1045 Washington, 1928) The New York Aquarium is very spacious and is able to keep under specially favourable conditions marine mammals and some of the larger fishes in addition to the smaller fishes and invertebrates usually to be found in the tanks In the large floor pools there are porpoises and various seals One unusually active Californian sea lion has lived nineteen years in the aquarium Even manatees, which are difficult because of their sluggish habit have lived there as long as seventeen months and two years respectively, a Jew fish of 200 pounds weight has been kept more than ten years, and smaller fishes such as the gar (*Lepidosteus*), mudfish (*Amia*), and striped bass (*Roccus*) for more than twenty four years Results are very good also in the smaller tanks and aquaria, and various exhibits, including fish hatching, are on view This very useful document includes not only the description of building and setting up of aquaria large and small with details of lighting, heating, water, and air supply and all other essentials, but also describes in detail the methods of collecting and transport of the various creatures, their general management, food, diseases and their treatment, together with the approximate cost of construction and upkeep The paper is illustrated by photographic figures showing apparatus and many of the aquarium animals

DR A C GOODINGS, a graduate of the University of Leeds, has been appointed to an important post under the Ontario Research Foundation on the recommendation of Dr S G Barker, of the British Research Association for the Woollen and Worsted Industries Dr Goodings, after taking first class honours in chemistry, entered the Department of Textile Industries with a Clothworkers' scholarship, and, working under Prof A F Barker and Mr J B Speakman, proceeded to the degree of Ph.D through textiles, and later took the post graduate diploma in textiles Dr Goodings'

studies have covered a wide field, including the chlorination of wool and other problems During the past session, as a Clothworkers' fellow, he has been engaged on research into the fundamental principles underlying worsted drawing and spinning

The Ninth International Horticultural Congress will be held in London on Aug 7–15 The papers to be presented will be divided into three main groups (1) Propagation, (2) pomology, and (3) botanical gardens and general subjects Many countries on the continent of Europe, including Russia, will be represented, and several papers are promised by distinguished American workers Particulars of the Congress and of the excursions which will follow it can be obtained from the secretary of the Royal Horticultural Society, Vincent Square, London, S W 1, at the invitation of which the gathering is being held

A preliminary notification has been issued of the twenty fourth International Congress of Americanists to be held in Hamburg on Sept 7–13, 1930 Questions of general import will be discussed by the Congress as a whole, but sectional meetings will also be held for papers dealing specifically with the aboriginal peoples of America and their ethnic relations, the prehistory of America, manners and customs of the various groups of Indians and their distribution in the Old and New World, the aboriginal languages, the discovery and colonisation of America, and the geography and geology of America, with special reference to human activities The subject of one general session will be the civilisation of the Indians at the time of their first contact with Europeans and to day, which will be opened by a report by Prof Sapper, of Wurzburg The arrangements for the Congress are in the hands of an organising committee, of which the chairman is Prof G Thilenius and the secretary Dr R Grossman Subscriptions should be sent to "Internationalister Kongress", c/o M M Warburg and Co, Bankers, Hamburg

Sterilised surgical catgut has been added to the schedule to the Therapeutic Substances Act, 1925, as being a substance the purity of which cannot be adequately tested by chemical means (*Statutory Rules and Orders*, 1930, No 26 H M Stationery Office Price 1*d*) Before sale of sterilised catgut, manufacturers must test, or have tested by a recognised institution, samples for the presence of living bacteria, and full directions are given of the procedure to be ollowed in carrying out this test

The annual 'Medical Directory' guide to British spas and marine health resorts, now entitled, "The Waters and Coasts of Britain", by Dr Fortescue Fox, has recently been issued (Messrs J and A Churchill, 40 Gloucester Place, W 1 1*s* net) Information is given respecting the situation, climate, and other features of the principal health resorts in the British Isles, together with the characters of their waters, if any, and the medical indications for their use Lists of hotels, hydros, and other residential accommodation are also included

The new Belfast Museum and Art Gallery has not been long in showing that it means to adopt the most up to date methods in educational propaganda A very attractive programme of Wednesday night lectures has been announced, and these and the exhibition of natural history and industrial films on Saturdays, have attracted audiences which crowd the lecture hall Naturalists' field clubs in Ulster are alive to the value of the Museum, and are gradually extending their membership and their activities

The issue for December 1929 of *Terrestrial Magnetism and Atmospheric Electricity* contains a portrait and brief obituary and appreciation of Dr J P Ault, commander of the non magnetic ship *Carnegie*, who lost his life in the destruction of the ship by an explosion at Apia on Nov 29 last A further list is given of the ocean magnetic results obtained on this seventh and last cruise of the *Carnegie*, the list relates to the period from June 25 to Sept 23, 1929, when the ship arrived at Honolulu

We are glad to find that *The Aquarist and Pond Keeper* is prospering It has already increased by four pages, and this year it is being published every alternate month instead of quarterly The winter number (No 8, vol 3, 1929) contains an interesting article on the breeding of the angel fish *Pterophyllum scalare* by the Rev Bertram Stower This is the first time that the angel fish has bred in Great Britain, and it has never been known to breed in captivity in such numbers It is estimated that three hundred young from the broods were alive in the pond at the age of three months The parents were still guarding their young, although some of them showed a certain amount of independence

The transactions of the Prague meeting, in September 1927, of the Section of Terrestrial Magnetism and Electricity of the International Union for Geodesy and Geophysics, appeared under date June 1929, at the close of last year, as *Bulletin* No 7 (pp 269 + xii) of the Section On account of the illness of Dr L A Bauer, secretary of the Section up to the close of the meeting, and now president, the bulletin was prepared by Dr J Fleming on his behalf, and has been printed under the care of Dr Ch Maurain, the present secretary It comprises the proceedings and minutes of the meetings (pp 54), special reports (pp 30), reports of national committees (pp 92), comments on the agenda, and various scientific communications (pp 80), and official information (pp 12)

Applications are invited for the following appointments, on or before the dates mentioned —Graduate assistants in mechanical engineering and electrical engineering at the Rutherford Technical College, Newcastle upon Tyne—The Director of Education, Northumberland Road, Newcastle upon Tyne (April 4) A temporary lecturer in civil engineering in University College, Rangoon — The Secretary to the High Commissioner for India, General Department, India House, Aldwych, W C 2 (April 5) A responsible teacher in the Engineering Department (Mechanical and Electrical Engineering), and a teacher of electrical engineering, at the Oldham Municipal Technical College

—The Secretary for Education, Education Offices, Oldham (April 10) An assistant master for mathematics and science at the Westcliff Day Technical and Commercial School—The Headmaster, Dav Technical and Commercial School, Fairfax Drive, Westcliff on Sea (April 11) A pathologist and an assistant pathologist in the Pathological Department of the Royal Northern Hospital—The Secretary, Royal Northern Hospital, Holloway Road, N 7 (April 12) Six temporary marketing investigators under the Ministry of Agriculture and Fisheries, for investigations into methods of agricultural marketing organisation — The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S W 1 (April 14) A director of the Bristol Municipal Museum and Art Gallery—The Town Clerk, Council House, Bristol (April 30) An assistant professor of biochemistry in the University of Alberta—The Secretary of the Board of Governors, University of Alberta, Edmonton, Canada (May 15) A professor of chemistry in the University College of North Wales—The Registrar, University College of North Wales, Bangor (May 24) A male temporary junior assistant metallurgist or metallurgical chemist under the Directorate of Metallurgical Research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S E 18 A lecturer in mathematics and physics at the Dudley Training College for Teachers—The Secretary to the Dudley Training College Council, Education Offices, Dudley A physicist under the Linen Industry Research Association, for work on applications of physical and colloid science to textile finishing processes—The Secretary, Research Institute, Lambeg, co Antrim An assistant pathologist in the Public Health Department of the Shanghai Municipal Council—J Pook and Co, 68 Fenchurch Street, E C 3 Two women B Scs at the Wellcome Physiological Research Laboratories for, respectively, biochemistry or chemistry and for the bacteriological department—The Director, Wellcome Physiological Research Laboratories, Langley Court, Beckenham

Our Astronomical Column

The Trans-Neptunian Planet — The following observations of position have been received those of Mar 12 and 17 were given only to the nearest second of time in R A

	U T	R A	N Decl	Place	Observer
Mar	12 125	$7^h\ 15^m\ 49\ 6^s \pm$	° ′ ″	Flagstaff	
	17 049	7 15 41 ±	22 7 18	Yerkes	van Biesbroeck
	19 0206	7 15 39 86	22 7 38	Königstuhl	Wolf
	21 0333	7 15 35 00	22 7 47	Neu Babelsberg	Struve

The planet is now approaching the stationary point, which it will reach about the end of March On the assumption of circular motion with radius 45 units, opposition would have taken place about Jan 9 4 U T, the longitude then being 108° 26 5′, and south latitude 12′ or 13′

Prof Shapley reports that the brightness has been measured at Harvard Observatory the magnitude is 16 0 (*Morning Post*, Mar 22) From its faintness it appears that the planet is not larger than the earth, and that its albedo is very low Dr Struve (who called the body a comet) gave the magnitude as 15 3

In all probability the mass is considerably below Lowell's estimate of 6½ times the earth's, in this case, it would be largely a matter of good fortune that his predicted longitude was so near the truth It is, however, just possible that a planet covered with liquefied gases would have a very low albedo, in which case its diameter might exceed the earth's

Comets.—Comet discoveries are coming in quick succession, and we are already assured of four perihelion passages in 1930, apart from the possible detection of the periodic comets D'Arrest and Tempel (2) Comet 1930 c was discovered by Mr Wilk, of Cracow Observatory It is his second discovery within three months The following positions have been received from the I A U Bureau

	U T	R A	N Decl	Observer	Place
Mar	$21^d\ 18^h\ 38\ 0^m$	$1^h\ 31^m\ 2^s$	18° 26′ ″	Wilk	Cracow
	22 19 46 7	1 29 21 2	19 55 11	Struve	Neu Babelsberg

Struve gave the magnitude as 5 9, so the comet should be an easy object in a small telescope The deduced daily motion is -97^s, N 85′, which would give R A $1^h\ 18^m$, N Decl 29° 50′ on the evening of Mar 29, about 7° south-east of β Andromedæ

The following elliptical orbits have been computed for Beyer's comet, 1927 *b* The equinox is 1930 0

T	1930 Apr 21 64 U T	1930 Apr 28 5760
ω	26° 27′	29° 54′ 53 4″
Ω	116 33	116 53 12 7
i	71 17	70 5 47 4
log q	0 3120	0 301150
Period	640 6 years	91 503 years
	Computer, Mr Bower and Miss Moore Observations, Jan 23, Feb 18 Mar 14	Dr C H Smiley Feb 19 Mar 2 13

The comet is a good deal fainter than Wilk's, but is approaching perihelion, and is visible with moderate instruments The following ephemeris is for 0^h U T (*I A U Circ* 258)

	R A	N Decl
Mar 29	$6^h\ 9^m\ 9^s$	39° 11′
Apr 2	6 11 42	40 32
6	6 14 52	41 49
10	6 18 36	43 3

Mr F E Seagrave finds a period of 20,000 years for Wilk's earlier comet, 1929 *d* This should only be taken to imply that there is very little deviation from parabolic motion

Observatory at Bedford College, London — The completion of a fresh wing at the Bedford College for Women (University of London) has made possible the erection of a small observatory on the roof of the new building The Woolwich Arsenal Institution, acting on the advice of the Astronomer Royal, generously handed over to the College a seven inch refracting telescope by Grubb, which had been at the Institution since 1872, and which it is now hoped will enter on a new sphere of usefulness The Astronomer Royal performed the opening ceremony on Mar 17, the chair being taken by Prof H H Turner Sir Frank Dyson gave an address on "Everyday Astronomy", in which he pointed out how little is known of astronomy from a practical point of view, even by educated people interested in the theoretical side, and indicated how the simpler phenomena may be studied by comparatively simple observations leading up to the more detailed observations which the telescope makes possible.

Research Items.

Systematic Studies of Mammals.—Mammalogy, in the curiously restricted sense in which Gerrit S. Miller uses the term in his review of the progress of this branch of zoology (*Smithsonian Report for 1928*, p. 391, 1929), concerns itself primarily with the systematic study of mammals. The advance which has been made in the cataloguing and classifying of the world's mammals is very striking. In 1758, Linnæus knew only 86 mammals, a century later Baird knew 220 kinds in North America alone, and now in the same limited portion of the earth's surface about 2500 forms are recognised. Especially since 1890 progress has been rapid, and this, strange to say, has to do with the invention of the break-back pattern of mouse-trap, which has played an invaluable part in bringing into the study the smaller denizens of woods and fields. In the 'nineties Trouessart's "Catalogus Mammalium" enumerated 4423 species; since his last volume appeared in 1898, not less than 8700 new names have been added to the list of living species and sub-species, and the process is continuing at an undiminished rate of about 250 a year. This and the general development of systematics is interesting and important, but mammalogy means more than this, and we wish that the author could have found space to refer to the great development which has taken place also in the study of the mammal as a living organism, for it is the biological trail that promises to lead furthest into the unknown.

Zebra-Horse Crosses.—In 1902, Cossar Ewart described successful crosses made between horses and Burchell's zebra. Afterwards in America the ass was successfully crossed with Grevy's zebra, which is larger and more docile, but matings with the horse failed. Mr. Elmer Roberts (*Jour. of Heredity*, vol. 20, No. 12) describes crosses since made in Indiana between a male *Equus grevyi* and thirty mares, beginning in 1912. Eight colts in all were reared. They were all chocolate coloured with black stripes, although the dams were of different colours, bay, black, and gray. Three of the colts were male and five female, but all were sterile. These zebroid hybrids were gentle and intelligent, somewhat smaller than horses, but beautiful in appearance. They were good workers, and were better able than horses to withstand high temperatures. Being easily trained, they would appear to be valuable as domestic animals, and in certain respects preferable to mules.

Japanese and Chinese Fishes.—Mr. Henry W. Flower has gathered together a large number of notes and records of fishes chiefly obtained from the markets of Japan, Shanghai, and Hong Kong ("Notes on Japanese and Chinese Fishes", *Proceedings of the Academy of Natural Sciences of Philadelphia*, vol. 81, 1929). Among those from Shanghai is a new species of barbus, *Barbus nigripinnis*, which the author places in the new sub-genus *Glabrobarbus*, differing from *Hemibarbus* in the presence of two barbels which are maxillary, and a very short snout, the dorsal spine being long and smooth. The lower fins are very dark, giving the fish a characteristic appearance. Most of the fishes listed are from Hong Kong, upwards of 180 species being recorded.

Collembola of Ireland.—In *Proceedings of the Royal Irish Academy*, Vol. 39, 39B11, January 1930, Mr. H. Womersley contributes a useful list of the Collembola of Ireland, adding 17 species to the 50 kinds already known from that country. His paper commends itself to all students of these obscure insects, since he provides diagnostic keys to the families, genera, and species of all the British forms. No comprehensive work on the latter is available at the present time, and Mr. Womersley's paper supplies a means for their identification once the student has familiarised himself with the structure of a few leading types and is able to dispense with the use of illustrations. Out of a total of more than 700 described species of the order, 153 are here listed as British. The need for a monograph on the group is becoming increasingly evident as Lubbock's well-known volume is now completely out of date. Collectors and observers of these insects are few and far between and even to-day there must be still a number of British species awaiting discovery.

Duration of Life in *Drosophila*.—Considerable quantitative studies have now been made on the influence of various environmental conditions on the length of life in *Drosophila*. It has been found that low temperature, ventilation, and alcohol prolong the duration of life in these flies, while various degrees of starvation with or without water shorten it. Mr. W. W. Alpatov (*Amer. Naturalist*, January 1930) has studied the effect of different kinds of feeding of the larval and imaginal stages on the life of the fly. In one experiment, small flies were produced by removing the larvæ from food before the normal end of larval feeding, but there was no effect on their longevity. It was already known that flies grown at low temperature were larger. Small flies can also be produced by growing them at high temperature, but the duration of life is different from that of the small flies produced by under-feeding. In other experiments, flies were kept on synthetic food with or without yeast. The absence of the yeast greatly reduces the length of life of both males and females. From earlier work of Pearl, it is concluded that the relation between temperature and duration of life is represented by a simple exponential curve, while the relation between starvation and duration of life follows the upper part of a logistic curve.

Mycorrhiza in the Ericaceae.—Prof. Knudson, of Cornell University, and Dr. Rayner discuss again this oft-debated question in the *New Phytologist*, Vol. 28, No. 5, December 1929. Prof. Knudson is of the opinion that he has grown *Calluna vulgaris* from seed, after sterilisation with calcium hypochlorite, and obtained perfectly healthy seedlings under sterile conditions. He is aware that Dr. Rayner has previously failed to do this, and argues that her sterilisation methods (with mercuric chloride) were so drastic that the seedlings never grew thoroughly healthily, and also suggests that injection with the fungus symbiont just tipped the balance in favour of growth, by its effect upon the residual mercuric chloride left on the seed coat from the washing operations. Dr. Rayner, however, argues that Prof. Knudson's grounds for regarding his seedlings as completely sterile are far from convincing, and that his subsequent methods of examining these seedlings would leave the hyphæ of the symbiont still undetected. Under the conditions of his experiment, the hyphal complexes in the host cells, characteristic of fully developed mycorrhizal infection, were not to be expected, the fineness of the normal mycelium necessitates a special technique for its detection.

Floods of the Seine.—The floods that periodically threaten Paris are due to the coincidence of sudden thaw and heavy rainfall in the east and south-east of the Paris basin. The result is that the Seine is unable to carry away the water quickly enough. Many

preventive measures have been suggested In *Matériaux pour l'Étude des Calamités*, 4, No 20, Dr E Joukowsky proposes a new solution of the problem by the boring of absorbent pits establishing com munication between the surface water and the subsoil This would result both in storage and in drainage The pits would be in river beds in order to save waste of land and preferably at river junctions They would be dug at some distance from any artesian well The value of the wells or pits would clearly depend on their number, diameter, and depths, and to decide these questions a careful study of the level of ground water and the absorption power of the soil would be required

Formation of Limestone - Most great limestone formations of past geological ages have had an origin independent of coral reefs, and were apparently laid down in relatively shallow seas Many were alter nately above water, with resultant sun cracking, and submerged, with marks of wave action On the Great Bahama Bank such conditions of deposition occur to day Waste of terrigenous origin is absent, and there are no coral reefs Yet a white chalky mud known as drewite is being deposited In the March number of *Discovery*, Mr M Black gives some account of a preliminary investigation of this deposit by an American expedition in which he took part Needle shaped crystals of aragonite and grains of calcium carbonate compose 90 per cent of drewite The re mainder is sponge spicules, tests of foraminifera, etc Hard lumps among the soft ooze proved to be com posed of crystalline calcite enclosing rather more foraminifera than ordinary drewite This recalls the recrystallisation of ancient limestones known as pseudo breccias The second recrystallisation by which the whole mass, and not merely the lumps, be come solid is still obscure, but it is probable that the cementation takes place when the aragonite needles are converted into calcite This, however, would appear to take place only in the layers that are buried, since the aragonite is comparatively stable in contact with sea water Further investigations are promised

***K* Absorption Edge of Zinc** —In their communica tion on "The Fine Structure of X Ray Absorption Edges", in NATURE of Oct 26, 1929, p 652, Prof D Coster and M Wolf remark that although they have had no difficulty in observing several secondary edges in the K absorption spectra of copper, they were unable to observe fine structure in the case of zinc Mr Suekichi Kawata, of the Physical Institute, Kyoto Imperial University, informs us in a letter dated Jan 25 that he has obtained three secondary edges with zinc in the zincblende used as an analysing crystal employ ing the method of Lindsay and others (G A Lindsay and G D Van Dyke, *Phys Rev*, 28, 1926, J C Nuttal, *Phys Rev*, 31, 1928) The energy differences relative to the main edge are (in ν/R) 12 3, 8 0 and 3 3, which may be the right order of magnitude of the energies of $M_{IV\ V}$, $M_{II\ III}$ and M_I of zinc or the next higher element gallium respectively The details of the photogram will not reproduce satisfactorily, but we submitted it to Prof Coster, who writes "I have seen the photo graph of the K-absorption edge of zinc obtained with the zinc of zincblende as analysing crystal It seems possible that Mr Kawata has really got a fine structure of this edge If this is true, the question which re mains to be solved is, whether there is an essential difference between the intensity of this fine structure in the case of zinc and that of copper as was supposed in the letter of Coster and Wolf (NATURE, Oct 26, 1929) or not Experiments are in progress at Gronin gen to try to settle this question"

Capture of Electrons by α-Particles —The first February number of the *Physical Review* contains further details of the experiments of A H Barnes on the capture of electrons by α particles In a pre liminary report published last year (see NATURE, Sept 7, 1929, vol 124, p 389), it had been claimed that capture occurred only when the relative velocity of the electron and α particle was the same as the speed of an electron in one of the inner Bohr orbits of singly ionised helium, or when the two particles were relatively at rest A similar result is now reported for the capture of two electrons to give a neutral atom of helium, and the form of apparatus which has been used is described This consists of an evacuated tube, holding an incandescent plate as a source of electrons, with a set of auxiliary electrodes to give the electrons any desired speed, and to determine their paths To avoid contamination, the α particles enter the tube through a thin glass window, and after passing through the cloud of electrons are sorted magnetically and detected by the method of scintillations, the zinc sulphide screens being set up either inside or outside the tube The total number of scintillations which have been counted is more than 7×10^5 Mr Barnes's results seem to show that electron capture takes place in less than 3×10^{-10} sec in a region where the electron density is probably not greater than 10^7 per c c

Prevention of Corrosion in Lead Buildings —*Bulletin* 6 and *Technical Paper* 8 of the Building Research branch of the Department of Scientific and Industrial Research (H M Stationery Office) deal with the above subject They are drawn up by Mr F L Brady and deal with the subject in a way likely to be of service to builders and architects

Mine Rescue Apparatus —We have received *Paper* No 47 of the Safety in Mines Research Board, which deals with a type of gas mask evolved by the Board on the basis of experiments by Dr S H Katz (of the U S Bureau of Mines), who has been working at Sheffield under a scheme of exchange of skilled in vestigators, and Mr C S W Grice (London H M Stationery Office, 9*d* net) The mask is of the hopcalite type, employing a specially prepared mixture of manganese dioxide and copper oxide which converts carbon monoxide into carbon dioxide The type of mask successfully used in the United States, known as the 'All Service' mask, has been improved so as to show appreciably less resistance to breathing, and the results are of importance not only to mine workers but also to firemen and other workers who are liable to encounter poisonous gases in the course of their occupation

Distillation under Low Pressure —The extraction from solutions of solids which readily undergo chemi cal change at high temperatures necessitates usually some form of vacuum still In the *Chemiker Zeitung* of Feb 19 will be found the description of a patent still which embodies some new features In the usual type of still, the resistance to the flow of vapour caused by the pressure of a column of vapour above the liquid often presents difficulty in operating on an extensive scale, moreover, the narrow cross section and rather sharp angle of the outlet tube tend to increase the difficulty These features are to a very great extent eliminated in the new design, in which the vapour is led from a wide tube near the surface of the boiling liquid to the condenser in such a way that very little of the condensed vapour flows back into the liquid The evaporating vessel is made of special resistance glass, which gives better results than porcelain The apparatus is supplied by the firm Greiner and Freid richs of Stutzerbach

The Structure of Silicates.*

By Prof W L BRAGG, F R S

DURING the last few years a number of silicate structures have been analysed by means of X-rays in the Physical Laboratories of the University of Manchester In the course of these investigations, we have found the atomic arrangement in the olivine, chondrodite, phenacite, pyroxene, and amphibole groups amongst the silicates of divalent metals, and in a number of aluminium silicates such as the forms of Al_2SiO_5, staurolite, topaz (analysed also by Pauling), beryl, and the zeolite analcite Other silicates analysed are titanite, and benitoite containing titanium, danburite containing boron, zircon (analysed also by Vegard) and thortveitite A group of workers has carried out these analyses, important contributions being made by Warren (pyroxenes and amphiboles), Zachariasen (titanite, thortveitite, benitoite), Naray (staurolite, cyanite), Taylor (forms of Al_2SiO_5 and analcite), and West (chondrodite group) Warren has just reported an analysis of the melitite group In addition, Menzer has analysed the garnet group, and Jaeger the family of compounds to which ultramarino belongs Preliminary observations have been published by Schiebold on the felspars, and by Mauguin on the composition of the micas So much ground has been covered that it is possible to review the silicates as a class of compounds, though of course such a survey must be of a very preliminary character

In the following description, the silicates will be considered in the light of the new knowledge of their atomic arrangement The conclusions arrived at often reflect well known and widely accepted views of their nature, but the X ray analysis has introduced a greater precision and many novel elements

The distinguishing feature of silicate structures may be described as their intermediate position between salts of acid radicals on one hand, and metallic oxides on the other We may consider the way in which oxygen is associated in crystal structures with the successive elements magnesium, aluminium, silicon, phosphorus, sulphur, and chlorine The last three form acid radicals $(PO_4)^{3-}$, $(SO_4)^{2-}$, $(ClO_4)^{1-}$, and these self contained groups (and also complicated groups such as $(S_2O_7)^{2-}$) combine with metallic ions to form salts Silicon also forms self contained groups such as $(SiO_4)^{4-}$, $(Si_2O_7)^{6-}$, and more complicated forms, which may, if we choose, be considered as acid radicals of the usual type The novel feature is introduced by its additional power of forming *silicon oxygen complexes with indefinite extension in space* It is this feature which gives rise to the vast variety of silicates and explains the difficulty of assigning chemical formulæ to them as if they were ordinary salts

The rôle played by silicon in the inorganic world has been compared to that played by carbon in the organic world, but there is an essential difference between them In organic chemistry the great variety of compounds is due to the possibility of continuing the link between carbon and carbon so as to form more and more complex groups In the silicates, there often is a similar indefinitely extended linking, but it is always one in which an oxygen atom is interposed between two silicon atoms The extended silicon oxygen linking is a transition towards the ionic lattices which metals such as magnesium form with oxygen The passage is the more gradual because aluminium can replace silicon in a silicon-oxygen complex, and at the same time can replace a metal such as magnesium Our very use of the term 'silicate', however, implies a separation of the silicon-oxygen groups in a somewhat arbitrary way from the rest of the structure and a consideration of them as acid radicals, and there is good reason for regarding the silicon oxygen bond as essentially different from the polar bond in an ionic crystal of metal and oxygen

In all compounds hitherto analysed, silicon is found at the centre of a regular tetrahedral group of oxygen atoms The oxygen atoms are about 2 6 A apart, and the oxygen silicon distance is 1 6 A These tetrahedral groups can link together by sharing an oxygen atom In general, the lower the ratio of oxygen to silicon in a silicate, the greater is the extent to which this linking takes place In this way, a range of structures is built up with a successive extension in space of the silicon oxygen linking, represented at one end by the orthosilicates with *independent* groups $(SiO_4)^{4-}$, and at the other end by the forms of silica such as quartz which W H Bragg and Gibbs first showed to be a structure of linked tetrahedra where *every* oxygen atom is shared by two silicon atoms

We can distinguish the following forms of silicon oxygen complex

(*a*) *Orthosilicates* —Independent groups $(SiO_4)^4$

(*b*) *Self contained Groups* —These are formed by linking a finite number of tetrahedral groups Examples are $(Si_2O_7)^{6-}$, $(Si_3O_9)^{6-}$, $(Si_4O_{12})^{8}$, $(Si_6O_{18})^{12-}$ The latter three groups are formed by linking three, four, or six tetrahedral groups in a ring (the sixfold ring in beryl is a striking example)

(*c*) *Silicon Oxygen Chains* —In the pyroxenes there is a simple chain of tetrahedral groups, each sharing an oxygen atom with its neighbours on either side, and thus leading to a composition represented by $(SiO_3)^{2-}$ It is interesting to note that this linking found by Warren and the author was predicted shortly before by Machatschki In the amphiboles two such chains are joined side by side by a further sharing of oxygen atoms or ' condensation ', leading to a composition $(Si_4O_{11})^{6-}$ These chains in the pyroxenes and amphiboles (and probably other types of chain in other compounds) lie side by side They are like acid radicals with indefinite extension in one dimension, and are bound together by the metallic ions They are parallel to the fibre direction in the fibrous forms which these compounds often assume

(*d*) *Silicon Oxygen Sheets* —If three oxygen atoms of each tetrahedral group are shared, the resulting ratio will be represented by $(Si_2O_5)^{2-}$ No compounds of this type have yet been analysed, but it is interesting to note two features The most direct way of linking tetrahedral groups into sheets leads to an arrangement which has hexagonal symmetry, and the dimensions of the network are precisely those of the basal plane of mica (measured by Mauguin) It may be that such sheets will be found to form the basis of the scaly minerals, such as mica, chlorite, and talc, which have a marked basal cleavage and pseudo-hexagonal structure

(*e*) *Three dimensional Silicon Oxygen Networks* —If every oxygen of the tetrahedral groups is shared between two silicon atoms, the structure will be silica, SiO_2 Machatschki first pointed out that if a certain proportion of the silicon were replaced by aluminium, the result would be a silica like arrangement of linked tetrahedra which had a total negative charge, and into which in consequence metallic cations could be incorporated This is the essential feature of ultramarine and the *zeolites*, and according to Schiebold

* Lecture delivered before the Mineralogical Society on Mar 18

of the *felspars* In some zeolites the ratio of aluminium to silicon is quite low, so we have justification for describing these structures as having acid radicals with endless extension in three dimensions The bearing of this on the ease with which the water content is changed and metallic ions substituted in the zeolites without breaking down a crystal, is obvious

These silicon oxygen complexes are bound together by metallic ions, which fit into the spaces between the large oxygen atoms The way in which the cations are incorporated is very interesting I first pointed out the prevalence in silicate structures of close packed regular groups of oxygen atoms, as if many cations such as Be , Al , Mg , Fe , Ti fitted into close packed groups of four oxygen atoms at the corners of a tetrahedron, or six at the corners of an octahedron, with little distortion Larger ions such as K , Ca , Na have often more oxygen atoms round them, and the group is distorted This is natural, for while four or six spheres packed together assume a regular tetrahedral or octahedral form, eight spheres can be packed together more compactly by a less regular arrangement than that at the corners of a cube In the next place, these metallic ions appear to be attracted to the oxygen atoms which have only *one* link to silicon Oxygen atoms linked to two silicon atoms have little external field, as if their valency were saturated It is very likely, as Lowry has insisted, that we must regard the silicon-oxygen link as wholly or partly a homopolar bond Oxygen atoms with a single bond to silicon behave as if they had a single charge $-e$, those with a double bond as if they were uncharged Another very important principle enters, which Pauling was the first to point out, in a general treatment of ionic compounds The metallic atoms are so incorporated into the structure that there is a *local balancing of electric charge* between cations and the negatively charged oxygen atoms These features are beautifully illustrated by models of silicate structures

West and myself, in a paper on the structure of certain silicates in 1927, directed attention to the *importance of oxygen in silicate formulæ* Oxygen atoms cannot be removed from the structure without breaking up the regular groups, and in most cases, owing to their relatively large size, additional oxygen atoms cannot be incorporated in the unit cell This applies not only to the oxygen atoms which are linked to silicon, but also to additional ions O″, OH′, F′ which are part of the structure, the latter ions taking up the same space as oxygen On the other hand, Al can replace Si or Mg, Mg, Fe, and Mn are interchangeable, Ca can replace Na, and so forth, in the familiar way Hence in giving the atomic composition of a silicate after a chemical analysis has been made, the relative numbers of the constituents must be so expressed that the absolute number of oxygen atoms is correct for that particular type of crystal This immensely simplifies the problem of composition in such substances as the silicates where isomorphous replacement is so frequent Mauguin's work on the micas, Warren's on the amphiboles, and Berman's study of the melilite group, afford examples The relatively large size of oxygen, and the constancy with which a distance of about 2 7 A between oxygen centres appears in the silicate structures, make it convenient to think of the silicates as based on an oxygen framework which determines their dimensions, a fact of which considerable use was made in the earliest analyses

Although so little ground has been covered we can begin to see the general lines on which this interesting class of inorganic compounds is based The technique of X ray analysis has reached a stage where the complexity of the structure is no barrier, for examples already worked out are as complex as any we are likely to encounter

A Large Power Plant at Billingham-on-Tees

IN a paper read to the Institution of Electrical Engineers on Mar 13, H A Humphrey, D M Buist, and J W Bansall gave a complete description of the new industrial power plant which has been erected by Imperial Chemical Industries, Ltd , for the factory at Billingham on Tees belonging to Synthetic Ammonia and Nitrates, Ltd The conditions governing the design of this power plant differ from those relating to a public electricity supply station The extension programme required nearly 7000 tons of steam per day for process purposes as well as 37,500 kilowatts of electrical power The quantity of steam required for process purposes is double that required to generate the electrical energy Hence the boiler plant capacity had to be made three times as great as if electrical power only had been required

Chemical works have an almost constant load , in technical language, their load factor is a hundred per cent and continuity of supply is of vital importance A cessation of power would not only cause a loss of output, but would also upset the steady conditions of temperatures and pressures on which the satisfactory operation of the plant depends The power plant, therefore, must have a sufficient stand by plant and means for bringing that plant rapidly into operation Everything has to be considered on the lines of ' safety first ' As the output of the plant has to be as great as that of the largest electricity station in Great Britain, great attention was paid to securing economy, in the generating costs

It was considered that 856° F was the highest safe temperature for ordinary steel superheaters, as a great deal has yet to be learned about ' creep ' stresses at this temperature Considerations of safety, therefore, led the designers to adopt a maximum boiler pressure of 815 lb per square inch As high pressure boilers must have distilled water feed, and as only sixty per cent of the necessary supply could be obtained from the condensed steam, 2500 tons of water have to be distilled every day to add to the ' make up ' feed

By passing the total amount of steam generated, including that required for process purposes, 23,800 kilowatts are obtained Two turbo alternators, each of 12,500 kilowatts, provide the working units, and one is added as a reserve It was stated that the estimated cost of the electric energy generated in the station is well below the cost of any electric generating station in the world depending on coal as fuel This is attributed to the use of the high pressure and high temperature steam The primary turbines pass a greater quantity of steam than would be available in an ordinary power station Owing to the locality, the coal is cheap, and there is an abundant supply of cooling water The load factor also is the highest possible

An ingenious method of supplying the two boiler and pulveriser buildings is adopted The raw coal is brought in by rail and dropped into underground bunkers, from which it is raised by hoists to overhead belt conveyors It is thus carried to overhead steel bunkers in the pulveriser house, where it falls through chutes to the weighers and thence to the mill hoppers,

where it is pulverised It is next carried to an overhead cyclone separator by an air stream driven by exhauster fans From the cyclones the pulverised coal drops through rotary air locks to screw conveyors, which distribute it to the fuel bunkers, of which there is one to each boiler From these bunkers the powder passes through feeders driven by motors, the speed of which can be varied Finally, it is picked up by the air stream from the primary air fans and fed to the burners The air for combustion is supplied by forced draught fans after having been brought to a temperature of about 500° F by preheaters

The main generating units consist of three 12,500 kw high pressure primary units and two 12,500 kw intermediate pressure condensing turbines The turbines run at 2400 revolutions per minute, and are direct coupled to three phase alternators This station marks an important advance in the design of high temperature and high pressure power plants It is the largest high pressure pulverised fuel plant in the world

University and Educational Intelligence.

MANCHESTER —A Consultative Committee on Cancer Research consisting of representatives of the University and of the Manchester Committee on Cancer, including the Christie Hospital and the Radium Institute, has been established The research work will be conducted in the University laboratories and will be directed and controlled by the Consultative Committee Dr C C Twort, who has been working nder uthe direction of the Manchester Committee on Cancer, has been appointed as director of the Department of Cancer Research

OXFORD —The Latin oration delivered on Mar 19 by the outgoing Senior Proctor, Mr L H Dudley Buxton, of Exeter College, contained an appreciative reference to Prof R V Southwell, who comes from Cambridge to succeed Dr Frewen Jenkin as professor of engineering science, and to Prof R Robinson, who takes the place of the late Prof W H Perkin in the Waynflete chair of chemistry A tribute was paid to the skill of the latter in the by paths of music and horticulture Reference was made to the increasing pressure upon library space caused in part by the desire of natural science to "extend beyond the flaming boundary walls of the universe" It was to be hoped that the labours of the Commission, the appointment of which was made possible by the munificence of our cousins in America, would be able to solve the difficult question of library accommodation In view of the invasion of the seat of the Muses by factories, noisy motor traffic, and of the sky itself by aeroplanes and the smoke of furnaces, it was not wonderful that the Radcliffe Observer (Dr Knox Shaw) should have forsaken his post of observation for "thirsty Africa", where the stars are still visible through a cloudless atmosphere Finally, the proposed zoological garden for the delectation of the populace is not regarded by all with approval

THE Royal Society of Medicine, 1 Wimpole Street, W 1, has accepted, as a trust, the sum of £1000 presented by Mr Norman Gamble for the purposes of providing a prize of £50 every fourth year for the best original work in otology carried out by any British subject, lay or medical, during the preceding four years, the balance of the fund to be used for the purpose of awarding grants in aid of research work in otology. Applications for the prize and for grants in aid must be received by the secretary of the Society not later than Sept 30 next

Historic Natural Events

Mar 29-31, 1901 **Snowstorms** —During the passage of a deep barometric depression across Ireland and Scotland, heavy snow fell in North Wales, Scotland, and the north of England, mainly on Mar 29 In some places the depth of snow was three feet on level ground, and it was piled by the wind in great drifts, especially on the Snowdon Range

Mar 30, 1912 **Antarctic Blizzard** —After reaching the south pole on Jan 17, Scott met with calms and light winds with powdery snow which formed a great hindrance to travel Finally, on Mar 20, a blizzard set in, so thick and violent that his party could not leave their tent A gale from west south west and south west continued for at least ten days, and was still blowing when Scott made the last entry in his diary on Mar 30 Every day the party had been ready to start for the depot, only eleven miles away, which would have saved them, but the air was full of whirling drift, and travel was impossible

Mar 30, 1924 **Floods** —The end of March and the beginning of April were marked by heavy rain and extensive floods in Europe, which were accentuated by a sudden thaw following a heavy snowfall In Poland at the end of March the Vistula stood 27 feet above its normal level, a height said not to have been recorded since 1570, and there was much damage and suffering In Jutland a newly built dam burst, and in Spain and Portugal the rivers overflowed their banks, Seville was flooded and many persons were drowned There were extensive landslides in Granada and northern Italy, and in Switzerland traffic was impeded by the heavy falls of snow which blocked the passes

April 1, 1427 **Heavy Rain** —It is recorded in Fabyan's "Chronicles" that "This yere was unreasonable of Wederynge, for it reyened mosli contynually from Ester to Myghelmasse, where through hay and corne was greatly hyndered"

April 1, 1917 **Great Snowstorm** —On the afternoon and evening of April 1, which was Palm Sunday, heavy snow fell in western Ireland, especially in East Clare By 5 30 P M it was nine inches deep on the roads about Broadford, and on the morning of April 2 all the roads were blocked by snow drifts several feet deep More snow fell on April 3, and the roads were not freed until the following day On the night of April 1, there was an intense frost, and two men riding home over a mountain pass were killed by the cold

April 1, 1922 **Landslide** —Heavy rains in Switzerland at the beginning of the month caused a serious landslide near Le Bouveret (Valais), in the Rhone valley The village of Les Evouettes was partially buried Floods were afterwards reported from all parts of the country and also in the Rhone valley in France, at Lyons the lower part of the town was under water There was a considerable amount of minor damage by avalanche and landslide throughout the month, owing to the continued rainfall

April 2-3, 1909 **Heavy Rain** —With depressions in the Atlantic and Mediterranean, heavy rain fell over the greater part of Ireland The average rainfall in the two days over the whole island was 1 69 in., corresponding with a total precipitation of 3558 million tons, or 797,000 million gallons of water The heaviest falls occurred in the south and south west, where several places received more than five inches

April 3, 1901 **Blood-rain Plant** During March and April the large evaporation tank at the former headquarters of the British Rainfall Organization in Camden Square was invaded by a microscopical water plant, which on April 3 was identified by Mr

V H Blackman as *Sphærella pluvialis*, the 'blood-rain plant' The water assumed a deep crimson tint, and resembled a pool of blood This organism is usually found in small pools, the water of which is occasionally carried up into the air by small whirl winds and afterwards falls as 'blood rain'

April 4, 1901 **Phosphorescent Sea**—At 8 30 P M, in the Persian Gulf, the officers of the s s *Kilwa* saw the sea instantly covered with faint moving phosphorescent light, not visible continuously as in ordinary phosphorescent displays, but the sea appeared like a field of corn rippling under a fresh breeze In a few minutes the ripples grew more regular in direction and appearance, coming from south south east, and as each ripple of light reached the ship, phosphorescent 'droppings' appeared close to the ship, the water having the appearance of the starry heavens, or as if large handfuls of small pebbles had been thrown into a lake of phosphorus The ripples were very regular, at half second intervals After a few minutes, the ship passed the centre of the display and the ripples came from north north west Their apparent speed was about 60 miles a minute, they were ripples of light only, there being no movement of the water

April 4, 1905 **Great Indian Earthquake**—The Kangra earthquake originated in the north eastern Himalayas, the meizoseismal area including Kangra and Dharmsala, where more than 18,000 persons were killed The disturbed area is one of the largest known, being little short of two million square miles The depth of the focus was estimated to lie between 12 and 21 miles The earthquake was unusual in one respect There were no dislocations visible on the surface, but a new line of levels carried out through a secondary epicentre at a distance of 120 miles from Kangra showed that the district, including Dehra Dun, had risen about 5 inches

April 5, 1926 **Record Rainfall in California**—At Opid's Camp, on the west front of the San Gabriel range, a rainfall of 1 02 in was registered in one minute The weather station at this place is equipped with a weighing raingauge, which makes an automatic record A second gauge of the same pattern had been installed temporarily alongside the regular gauge, and the two gauges showed the same reading

Societies and Academies

LONDON

Geological Society, Feb 26—S E **Hollingworth** The glaciation of western Edenside and adjoining areas, and the drumlins of Edenside and the Solway basin In the lowland areas the threefold sequence of Early Scottish, Lake District Edenside, and late Scottish glaciations is recognised Almost the whole of the deposits are referable to the maximum of the second or main glaciation A great flood of ice travelled anti-clockwise around the northern end of the Lake District—first northwards towards the Solway, and then westwards and south-westwards into the Irish Sea Basin, it was joined en route by ice from the Lake District valleys Some twenty stages in the retreat from the Eden back to the valley-glacier stage are recognised The ice-fronts were, during the retreat, parallel to the trend of the drumlins over extensive areas This unexpected result led to the study of the drumlins of the much wider area, embracing all Edenside and the Solway Basin, from which it appears that the drumlins were formed at the maximum of the Main or Lake District Edenside glaciation, and not—as has been frequently claimed for other areas—at a late stage

Physical Society, Feb 28—C N H **Lock** The equations of motion of a viscous fluid in tensor notation An outline of the tensor calculus for three dimensions is given, and an attempt is made to develop the theory of the motion of a fluid, by tensor methods, as far as the general equations of viscous flow—W L **Watton** A new type of Dewar flask, for use as a calorimeter The water equivalent of a new type of Dewar flask, of which the inside is of copper, has been measured at laboratory temperatures, and found to be more constant than the usual type—R O **Cherry** Field intensity measurements around some Australian broadcast stations A simple loop, condenser, and valve voltmeter circuit has been employed and careful tests show that this method is available for the measurements of intensities as low as 1 millivolt/metre The field strength contours of three broadcast stations have been determined From these the following conclusions have been drawn (i) Very rapid attenuation of the signal is caused by Australian forest areas, this curtails enormously the areas for which a satisfactory service is provided (ii) The effective conductivity of the various types of ground surface met with varies from 4×10^{-13} to $0\ 07 \times 10^{-13}$ e m u, according to the number of trees in the areas covered (iii) The use of a longer wave length gives a marked increase of intensity at distant points beyond forest areas (iv) For daylight transmission over sea water up to a distance of 85 miles, after the application of curvature corrections to the intensity, Sommerfeld's formula is correct, to within the limits of experimental error (v) The efficiency of radiation of the three aerials examined ranges from 48 per cent to 60 per cent Atmospherics and other disturbances are less prevalent in Victoria than in Europe or America

Institute of Metals (Annual Meeting), Mar 13—D **Hanson**, S L **Archbutt**, and **Grace W Ford** Investigation of the effects of impurities on copper Part 6 The effect of phosphorus on copper Phosphorus removes oxygen from copper and improves its casting properties Small amounts of oxygen can be found together with phosphorus in copper, depending on the amount of phosphorus present Removal of oxygen by phosphorus improves the cold working qualities of copper Copper containing up to 0 95 1 2 per cent phosphorus can be hot rolled, and up to 0 79 0 95 per cent cold rolled from cast billet Phosphorus improves all mechanical properties of copper studied, and raises the softening temperature of cold-worked material It is seriously detrimental to electrical conductivity The wrought alloys of higher phosphorus content exhibit a small amount of age-hardening after suitable heat treatment—R **Genders** The aluminium brasses Over certain ranges of composition, the presence of aluminium in brass has a beneficial influence in several directions, especially as regards resistance to corrosion and to oxidation at high temperatures The composition of the alloys can be adjusted to give a wide range of mechanical properties—C F **Elam** The diffusion of zinc in copper crystals This only takes place to a limited extent at high temperatures When a β brass crystal was heated in zinc vapour, a layer of γ brass was deposited which was also a crystal The relationship between the two crystals was found to be sometimes parallel growth and sometimes a twin—L **Davies** and L **Wright** Protective value of some electro-deposited coatings Specimens of steel, brass, phosphor bronze, and copper were plated with cadmium, zinc, nickel, and chromium, of thicknesses 0 0001 in, 0 0005 in, 0 001 in, and 0 002 in, and exposed to corrosion

sprays of salt and sulphuric acid Cadmium afforded better protection than zinc against the sulphuric acid spray Against the salt spray, the thinnest deposits of zinc gave better protection than the corresponding cadmium deposits In general, for equal thicknesses of zinc and cadmium, the intrinsic protection afforded by the zinc more than compensates for its higher solution potential Chromium deposits afforded no protection whatever to steel, but very good protection was afforded to the non ferrous basis metals A deposit of 0 002 in nickel is necessary to give any degree of permanent protection to steel For general purposes, nickel deposits are most suitable, but no deposit can be recommended unless the service conditions are known —**R Lancaster and J G Berry** A note on zinc base die casting alloys Small quantities of magnesium added to a zinc base alloy, hardened with copper and aluminium, causes a variation in the physical properties, and a distinct change in the crystalline structure —**Bernard P Haigh and Brinley Jones** Atmospheric action in relation to fatigue in lead An oil bath round the test-piece, or even a water bath, greatly delays fatigue in lead, and a thin layer of grease delays fatigue appreciably A bath of acetic acid appears to eliminate fatigue in lead, although a thin film of the same acid does not do so The fatigue fracture of lead is intercrystalline only round the margin It appears that oxygen diffuses through lead subject to cyclic stress, and that, at an appreciable depth below the surface, it provokes a conjoint chemical and mechanical action that leads to fatigue cracking —**W R D Jones** A note on metallic magnesium Redistilled magnesium of 99 99 per cent magnesium is obtainable at such a reasonable price, in view of its purity, that it can be used in metallographic researches

Edinburgh

Royal Society, Mar 3 —**W N McClean** River flows of the Ness Basin After explaining briefly the need for flow measurements and for continuous records of water levels on our river systems, the author points out the peculiar value of the Ness Basin for navigation, fishing, water supply, and water power The measurements described form the basis of the quarterly reports giving the daily rainfall, water level, and flow of the rivers of the Ness Basin (See Nature, Mar 1, p 334)—**Gertrude Lilian Elles and Cecil Edgar Tilley** Metamorphism in relation to structure in the Scottish Highlands The tectonic structure of the Dalradian sediments of the south west and central Highlands is considered in detail in relation to the regional metamorphism which these rocks display A zonal metamorphic map of the greater part of the area has been made The fundamental large scale folding of the type postulated by E B Bailey is confirmed, but a different structural interpretation of the Loch Awe region is suggested The identity of the Ardrishaig and Ben Lawers schists as seen in the critical area in the vicinity of Dalmally is upheld and the rocks of the Loch Awe basin are considered as a continuation of the rock sequence of the Cowal area A table of correlations of the rocks of the several districts (Islay, Ballachulish, Loch Awe, Loch Tay, etc) is given, the stratigraphical sequence as developed beginning with the Eilde Flags Individual correlations include

Islay Lime stone and Black Schists	=Ballachulish Limestone and Slates	=Tayvallich Limestone and Schists	=Blair Atholl Series

and the identity of the well-known boulder beds of Portaskaig, Loch na Cille, and Schiehallion The metamorphism is regarded as developing in an original Dalradian geosyncline a depth metamorphism in which temperature and the stress necessarily incident upon increase of temperature have been the prime factors The development of large scale recumbent folding during this process has led to inversion of the metamorphic zones over wide areas

Paris

Academy of Sciences, Feb 17 —**A Buhl** The planification of families of analytical surfaces —**Marcel Brelot** The equation $\Delta u = c(x, y)u(x, y)(c>0)$ —**Michel Fekete** The changes of sign of a function in a given interval —**Basile Demtchenko** A mixed problem —**Vladimir Bernstein** Integral functions and Dirichlet's series —**Paul Lévy** Some inequalities relating to integral functions —**L Pirot** The determination of the astronomical positions in view of the study of the deviation from the vertical in the peninsula of Brittany —**Luis Rodés** The diurnal and annual periods in the distribution of 1944 earthquakes recorded by the same seismograph The analyses show that changes of temperature due to the sun, though slight, are an important factor in the production of earthquakes —**D Chalonge and Ny Tsi Zé** The continuous spectra of hydrogen connected with the Balmer and Paschen series —**G Déjardin and R Ricard** The structure of the first spark spectrum of mercury (Hg II) —**J Perreu** The limiting heat of solution of sodium hyposulphite and of hydrated magnesium sulphate —**Armel Sévault** The special aluminium bronzes with zinc, silicon, and antimony Tables are given showing the influence of zinc and of silicon on the hardness of aluminium bronzes —**Ch Bedel** Compact fused silicon and the density of this element Accurate density measurements on samples of silicon prepared in various ways showed that crystallised silicon and fused silicon have the same density, 2 33, provided that the fused silicon, which is liable to contain some small cavities, is powdered before taking its density —**Georges Laude** New syntheses of cyanic acid and urea by oxidation of carbon and its derivatives in the presence of ammonia The oxidation of numerous organic compounds was effected by a solution of potassium permanganate in the presence of concentrated ammonia In every case the production of a cyanate was proved this included even sugar carbon —**Deluchat** A class of benzene glycols A description of the preparation and properties of glycols of the type $C_6H_4(CH\ OH\ R)_2$, in which R was methyl, ethyl, propyl or benzyl —**R Cornubert** The possible existence of several dibenzylidene-cyclo pentanones —**Marcel Godchot and Max Mousseron** The hydrogenation of octohydrophenazine —**Ch Brioux and Edg Jouis** The neutralising action of hydraulic lime silicates on the soil —**Cannon** The sympathetic system as an agent of stability of the organism After removal of the two sympathetic trunks, the animals (dog, cat, ape) lived in the laboratory several months The basal metabolism was unchanged and the reproductive functions remained intact Temperature control was affected and resistance to heat and cold was reduced The other changes produced were such that the animals if set free could not long maintain their normal existence —**F Rathery, R Koubilsky and Mlle Yvonne Laurent** The glycæmic recharge of the liver —**Philippe Fabre** The law of neuromuscular stimulation by short electric discharges in man —**A Leulier and L Revol** The localisation of virtual adrenaline —**G Mouriquand, A. Leulier and P Sedallian** The arrest of the diphtheric intoxication by the placenta The experiments described show that in the guinea-pig the placenta arrests the diphtheric toxin, or at least, the phenomena of intoxication to which it gives rise, especially so far as the suprarenal capsules are concerned.

Official Publications Received.

BRITISH

Publications of the South African Institute for Medical Research No. 24 A Comparative Study of the Aptitude of the Higher Animal Organism to acquire Immunity throughout the Vital Cycle and the relation of this Aptitude to Hereditary Transmission By Dr E Grasset. Pp. 171 190 No 25 Plague Studies. i. Bacteriophage in the Prophylaxis and Treatment of Experimental Plague ii Microbic Dissociation of *B pestis* and its Importance in connection with the Preparation of Plague Vaccine and Serum iii A Veld Rodent Epizootic due to a *Pasteurella* other than *Pasteurella (Bacillus) pestis* By Dr J H Harvey Pirie Pp. 101 280 (Johannesburg)

Air Ministry Aeronautical Research Committee Reports and Memoranda No. 1269 (Ae 415) Full Scale Maximum Lift Coefficient of R.A F 28 Section Wing By E T Jones and K W Clark (T 2815) Pp. 2+2 plates 8d. net. No. 1270 (Ae 416) The Full Scale Determination of the Lateral Resistance Derivatives of the Bristol Fighter Aeroplane Part 3 The Determination of the Rate of Roll Derivatives By E T Jones. (T 2828) Pp. 7+6 plates 9d. net. No. 1272 (Ae 418) Wind Tunnel Tests with High Tip Speed Airscrews, Experimental Investigation of Blade Twist under Load By Dr G P Douglas W G A Perring and R A Fairthorne (T 2803) Pp 7+2 plates 6d. net No 1271 (Ae 417) Investigation of the Boundary Layers and the Drags of two Streamline Bodies (T 2832) Pp. 19+11 plates 1s 3d net. No 1273 (Ae 419) Experiments on an Ape Aeroplane fitted with Pilot Planes By S. Scott Hall (T 2814) Pp. 5+8 plates 9d net (London H M Stationery Office.)

The Journal of the Astronomical Society of South Africa Edited by Dr H Spencer Jones Vol. 2 No 4 January Pp 141 212 (Cape Town) 2s.

Ministry of Health Advisory Committee on the Definition of Drugs for the Purposes of Medical Benefit First Report. Pp. 6 Second Report Pp 9 (London Ministry of Health)

Publications of the Safety in Mines Research Board Vol 4 1928 Reports and Papers relating to Research with Coal Dust, Firedamp and other Sources of Danger in Coal Mines Pp 10 (London H M Stationery Office) 2d. net.

The Institution of Mechanical Engineers Annual Report of the Council for the Year 1929 Pp 40 (London.)

University of Leeds Twenty fifth Report, 1928-29 Pp. 165 Publications and Abstracts of Theses by Members of the University during Session 1928-29 Pp 40 (Leeds)

The National Institute of Industrial Psychology Studies in Vocational Guidance, Report 3 Tests of Mechanical Ability By F M Earle A Macrae, and other Members of the Institute's Staff Pp 42 (London.) 3s 6d

The Proceedings of the Physical Society Vol 42, Part 2 No 232, February 15 Pp viii+43 151 (London) 7s net

Journal of the Society for the Preservation of the Fauna of the Empire New Series Part 10 Pp 58 (Hertford Stephen Austin and Sons, Ltd) 1s. 6d.

Ministry of Agriculture and Fisheries. Marketing Leaflet No 16 The Pig Industry in England and Wales Interim Report by the Pig Industry Council Pp 9 (London Ministry of Agriculture and Fisheries)

Department of Scientific and Industrial Research Building Science Abstracts Compiled by the Building Research Station and published in conjunction with the Institute of Builders Vol 3 (New Series), No 1, January Abstracts Nos 1 241 Pp ii+35 (London H M Stationery Office) 9d. net

Journal of the Indian Institute of Science Vol 13A, Part 1 Some peculiar Lowlying Soils of Central Travancore By T R. Narayana Pillai and V Subrahmanyan Pp 10 (Bangalore) 12 annas

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society Edited by H Munro Fox Vol 5, No 1, January Pp. 90 (Cambridge At the University Press) 12s. 6d. net

Publications of the Dominion Observatory Ottawa. Vol 10 Bibliography of Seismology No 2 April, May, June, 1929 By Ernest A Hodgson Pp. 19-34 25 cents No 3 July, August, September, 1929 By Ernest A Hodgson Pp 35 47 25 cents (Ottawa F A Acland)

Air Ministry Aeronautical Research Committee Reports and Memoranda. No 1267 (Ae 413) Reduction of Drag of Radial Engines by the Attachment of Rings of Aerofoil Section, including Interference Experiments of an Allied Nature, with some Further Applications By H C H Townend (T 2819) Pp 77+29 plates (London H M Stationery Office) 4s. net

Ministry of Agriculture and Fisheries Reports on Salmon and Fresh water Fisheries for the Years 1925, 1926, 1927 and 1928 Pp. 138 (London H.M Stationery Office) 7s. net.

Journal of the Royal Statistical Society Vol 93, Part 1 Pp. 184+xii (London) 7s. 6d.

Proceedings of the Royal Society of Edinburgh, Session 1929-1930 Vol. 50, Part 1, No 1 Variations of the Rest Metabolism of the Rat in relation to the Sex Cycle By Dr A. C. Fraser and Dr B P Wiesner Pp 7 9d Vol 50, Part 1, No. 2 Further Invariant Theory of two Quadratics in n Variables. By H. W Turnbull and J Williamson Pp. 8 25. 1s 6d. Vol. 50, Part 1, No. 3 Some Observations on the Thymus Gland in the Fowl By A. W Greenwood. Pp. 26-37 1s. (Edinburgh Robert Grant and Son, London Williams and Norgate, Ltd)

The Scientific Proceedings of the Royal Dublin Society Vol 19 (N S.), No. 33 Study of the Polysaccharides Part 1 Inulin and Inulase. By J Reilly and P P Donovan Pp. 409-414. (Dublin Hodges, Figgis and Co., London Williams and Norgate, Ltd) 6d.

Journal of the Chemical Society February Pp. iii+185-321+viii. (London)

The National Institute of Industrial Psychology Annual Report and Statement of Accounts for the Year ended December 31st, 1929 Pp. 31 (London)

University of London: University College. Report of the University College Committee (February 1929-February 1930), with Financial Statements (for the Session 1928-29), and other Documents, for Presentation to the Senate. Pp. 196. (London.)

Ceylon Journal of Science Section A Botany Annals of the Royal Botanic Gardens, Peradeniya Edited by A. H G Alston Vol 11, Part 3 January 30th Pp 213 305+plates 25-44 (Peradeniya Department of Agriculture London Dulau and Co, Ltd.) 3 rupees

British Research Association for the Woollen and Worsted Industries. Report of the Council, 1929-30 Pp. 50 (Leeds)

The Agricultural Department, Madras Bulletin No 97 Results of Demonstrations of Agricultural Improvements in the Madras Circle carried out in 1924-1927 Compiled by Rao Bahadur D Ananda Rao Pp ii+89 8 annas Bulletin No. 98 Pepper Cultivation on the West Coast. By M Govinda Kidavu and P A Venkateswaran Pp. 10 2 annas. Bulletin No 99 Results of Experiments at Samalkota on Intermediate Season Cropping Pp 12 2 annas (Madras Government Press)

FOREIGN

Report of the Secretary of the Smithsonian Institution for the Year ending June 30, 1929 (Publication 3031) Pp vii+144 (Washington, D C Government Printing Office)

Library of Congress Report of the Librarian of Congress for the Fiscal Year ending June 30, 1929 Pp xvi+309 (Washington, D C Government Printing Office)

Year Book of the International Hydrographic Bureau Monaco, 1930 Pp 178 (Monaco)

Report of the Director of the Institute for Biological Research, 1928-1929 Pp 15 (Baltimore, Md Johns Hopkins University)

United States Department of Agriculture Weather Bureau Monthly Weather Review Supplement No 33 Climate of Mexico By John L Page (W B No 999) Pp 30 (Washington, D C Government Printing Office) 15 cents.

Instituts scientifiques de Buitenzorg ' s Lands Plantentuin Treubia recueil de travaux zoologiques hydrobiologiques et océanographiques Vol 7, Suppl, Livraison 4, Décembre 1929 Pp 149 164 (Buitenzorg Archipel Drukkerij) 2.50 f

The Boston Society of Natural History, 1830-1930 Edited by Capt. Percy R Creed Pp xii+117 (Boston, Mass)

Proceedings of the United States National Museum Vol 76 Art. 24 A Systematic Classification for the Birds of the World By Alexander Wetmore (No 2821) Pp. 8 Vol 76, Art 25 New Species of Ichneumon Flies and Taxonomic Notes By R A Cushman (No 2822) Pp. 18 (Washington D C Government Printing Office)

United States Department of Commerce Coast and Geodetic Survey Special Publication No. 158 Bilby Steel Tower for Triangulation By Jasper S Bilby Pp v+28 (Washington, D C Government Printing Office) 15 cents

United States Department of Agriculture Technical Bulletin No 147 The Habits and Economic Importance of Alligators By Remington Kellogg Pp 36 10 cents Technical Bulletin No 161 Life History, Habits and Control of the Mormon Cricket By Frank T Cowan Pp. 28. 10 cents (Washington D C Government Printing Office)

University of Illinois Engineering Experiment Station Bulletin No 198 Results of Tests on Sewage Treatment By Prof Harold E Babbitt and Harry E Schlenz Pp 98 55 cents Bulletin No 199 The Measurement of Air Quantities and Energy Losses in Mine Entries Part 4 Investigations in Timbered Entries By Cloyde M Smith Pp 50 30 cents. Bulletin No 200 Investigation of Endurance of Bond Strength of various Clays in Moulding Sands By Carl H Casberg and William H Spencer Pp. 28. 15 cents Bulletin No 201 Acid Resisting Cover Enamels for Sheet Iron By Prof Andrew I Andrews. Pp. 46 25 cents. (Urbana, Ill)

Smithsonian Institution Publication 2995 Mammalogy and the Smithsonian Institution By Gerrit S Miller Jr (From the Smithsonian Report for 1928) Pp 391 411+8 plates Publication 2996 The Controversy over Human Missing Links By Gerrit S Miller, Jr (From the Smithsonian Report for 1928) Pp 413 465 + 5 plates (Washington, D C Government Printing Office)

Suomalaisen Eläin ja Kasvitieteellisen Seuran Vanamon Julkaisuja. Osa 10, No 1 Über Entwicklung und Vererbung (eine theoretische Studie) Von Gunnar Ekman Pp. 141 (Helsinki)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan Third Series (Mineralogy, Petrology, Economic Geology) Vol 3 No 3 Pp 161 270 (Tokyo and Sendai Maruzen Co Ltd) 2 00 yen

Japanese Journal of Mathematics Transactions and Abstracts Vol 6 No 3 Pp. ii+251 318+8 (Tokyo National Research Council of Japan)

Proceedings of the Imperial Academy Vol 5, No. 10, December 1929 Pp. xxiii xxvi+448-486 (Tokyo)

Collection des travaux chimiques de Tchécoslovaquie Rédigée et publiée par E Votoček et J Heyrovský Année 2, No 2, Février Pp. 65-112 (Prague Regia Societas Scientiarum Bohemica.)

Journal of the Faculty of Science, Imperial University of Tokyo Section 1 Geology, Mineralogy Geography, Seismology Vol 2, Part 9 Mollusca Fossils from Karafto By Matajiro Yokoyama. Pp. 369 398+plates 71 76 1 10 yen Vol 3, Part 1 The Iwatsuki Seismic Zone as a Factor of the Habitual Tokyo Earthquake By Dr Bundjiro Kotô Pp vi+28+4 plates. 1 00 yen. (Tokyo Maruzen Co, Ltd)

Carnegie Institution of Washington. Annual Report of the Director of the Department of Terrestrial Magnetism. (Reprinted from Year Book No 28, for the Year 1928-29) Pp 209-276 (Washington, D C)

Bulletin of the National Research Council. No 73 A Survey of the Law concerning Dead Human Bodies By George H Weinmann. Issued under the Auspices of the Committee on Medicolegal Problems. Pp. 199 2 dollars. No. 74 Report of the Conference on Midwestern Archæology, held in St. Louis, Missouri, May 18, 1929 including a Report of an Open Meeting of the Committee, held May 17, 1929 Pp 120 1 25 dollars (Washington, D C. National Academy of Sciences)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 81 A Mississippian Fauna collected by Miss Eleanor T Long from Windsor, Nova Scotia. By W A. Bell Pp. 617-628+plates 22 23 A new Kingfisher from East Africa First Preliminary Paper on the Birds collected during the Gray African Expedition, 1929 By W Wedgwood Bowen. Pp. 627-631. (Philadelphia.)

Reprint and Circular Series of the National Research Council No. 90 Enzyme Catalysts Seventh Report of the Committee on Contact Catalysis, National Research Council By E F Armstrong and T P Hilditch. Pp. 15 25 cents. No. 91 Doctorates conferred in the Sciences by American Universities, 1928-1929 Compiled by Callie Hull and Clarence J West. Pp 46. 50 cents (Washington, D C National Academy of Sciences.)

United States Department of Commerce Bureau of Standards Bureau of Standards Journal of Research Vol 3, No 6, December 1929 Pp 929 1052 (Washington, D C Government Printing Office)

U S. Department of Commerce Coast and Geodetic Survey Annual Report of the Director, United States Coast and Geodetic Survey to the Secretary of Commerce for the Fiscal Year ended June 30 1929 Pp. iii+41+17 plates 15 cents Serial No 452 Results of Observations made at the United States Coast and Geodetic Survey Magnetic Observatory near Honolulu, Hawaii, in 1923 and 1924 By W N McFarland Pp ii+106 30 cents. (Washington, D C Government Printing Office)

CATALOGUES.

B D H Vitamin Products their Composition and Uses Pp 4 (London The British Drug Houses, Ltd)

Catalogue of Important Works on Botany Herbals Phanerogams, Floras and Cryptogams, Zoology and Geology (No 11) Pp. 20 (London John H Knowles)

Diary of Societies.

FRIDAY, MARCH 28.

ROYAL SOCIETY FOR THE PROTECTION OF BIRDS (at Middlesex Guildhall Westminster) at 3 —Annual Meeting

ROYAL SOCIETY OF MEDICINE (Disease in Children Section) (Clinical Meeting at King's College Hospital), at 5

PHYSICAL SOCIETY (Annual General Meeting) (at Imperial College of Science), at 5 —Presentation of the Duddell Medal to Prof A A Michelson —At 5 45 (in Electrical Engineering Department of the City and Guilds Engineering College) —Exhibition of Research Work now in Progress

INSTITUTION OF ELECTRICAL ENGINEERS (North Western Centre, jointly with Manchester Association of Engineers) (at Manchester), at 7 15 —J Calderwood Marine Diesel Installations, with particular reference to Auxiliary Machinery

JUNIOR INSTITUTION OF ENGINEERS (at Royal Society of Arts), at 7 30 —G S Taylor Industrial Accidents, their Cause and Prevention (Gustave Canet Memorial Lecture)

ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8 —Dr W Fletcher Typhus like Diseases of Unknown Ætiology

PHILOLOGICAL SOCIETY (at University College), at 8 —L C Wharton Slav Philologists Congress

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Sir Ernest Rutherford The Transmutation of Matter

INSTITUTION OF ELECTRICAL ENGINEERS (West Wales (Swansea) Sub-Centre).

SATURDAY, MARCH 29

BRITISH MYCOLOGICAL SOCIETY (in Botany Department, University College), at 11 A M —Miss E M Blackwell and Miss G M Waterhouse Spores and Spore Germination in the Genus *Phytophthora* —Miss M Brett Stemphylium Alternaria —K St G Cartwright The Study of Basidiomycetes in Culture —S Dickinson The Genetics of the Smut Fungi —Exhibition by S P Wiltshire on The Preservation of Petri Dish Cultures of Fungi

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —Sir Ernest Rutherford Atomic Nuclei and their Structure (4).

MONDAY, MARCH 31

INSTITUTE OF ACTUARIES, at 5 —C. F Wood Experiments in Modified Forms of Select Mortality Tables

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7 —Capt. P P Eckersley and others Discussion on Loud Speakers

ROYAL SOCIETY OF ARTS, at 8 —Comdr F G Cooper Aids to Navigation (Thomas Gray Lectures) (2)

TUESDAY, APRIL 1

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Dr C Singer The Passage from Mediæval to Modern Science (4) The Scientific Crux

ZOOLOGICAL SOCIETY OF LONDON, at 5 30 —Major R W G Hingston In the Tree Roof of the Guiana Forest.—Prof A Meek Further Notes on *Bipinnaria asterigera* from the Northumberland Plankton (Echinoderma).—Nellie F Paterson The Bionomics and Morphology of the Early Stages of *Paraphædon tumidulus* Germ. (Coleoptera, Phytophaga, Chrysomelidæ).—C. P Gnanamuthu The Anatomy and Mechanism of the Tongue of *Chamæleon carcaratus* (Merrem).—J Omer Cooper Report on the Gyrinidæ (Coleoptera) collected during Dr Hugh Scott's and Mr Omer-Cooper's Expedition to Abyssinia.

LONDON NATURAL HISTORY SOCIETY (at Winchester House, E C), at 6 30.—A. D Middleton Red and Grey Squirrels

INSTITUTION OF ELECTRICAL ENGINEERS (North Western Centre) (at Engineers' Club, Manchester), at 7 —H A Humphrey, D M Buist, and J W Bansall The Imperial Chemical Industries Limited's Steam and Electric Power Plant at Billingham.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7 —H Pickwell The Pilgrim's Way

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7 30 —Capt. J S Irving Some Problems Encountered and Overcome in the Design and Construction of the *Golden Arrow* —J H Hyde and Dr F Aughtie Measurements made of the Power and Efficiency of a Motor Lorry Gear Box

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (Annual General Meeting) (at Leicester Museum), at 8

WEDNESDAY, APRIL 2

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—R. H Barfield Recent Developments in Direction Finding Apparatus. (Part 1 Medium Wave Apparatus, 250-600 metres. Part 2. Short Wave Apparatus, 12 50 metres)

INSTITUTION OF ELECTRICAL ENGINEERS (Tees Side Sub-Centre) (Annual General Meeting) (at Cleveland Technical Institute, Middlesbrough), at 7 —At 7 30 —L C Grant The Breaking Performance of High Power Switchgear and of a New Form of Quenched Arc Switch

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—Prof M Eldin Bey The Detection and Identification of Alkaloids in the Saliva and Salivary Glands.—Ella M Collin The Separation of Cadmium and Copper in Spelter and Zinc Ores by Internal Electrolysis —A F Lerrigo The Routine Detection of Nitrites in Milk.—Dr J C Ghosh A Method for the Determination of Titanium as Phosphate

ROYAL SOCIETY OF ARTS at 8

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section) (Reception at Wellcome Historical Medical Museum) at 8 30 —Lord Dawson of Penn Henry Hill Hickman

ROYAL SOCIETY OF MEDICINE (Surgery Section), at 8 30 —C M Page, P J Verrall Dr R D Langdale Kelham and Capt A. R Maxwell Discussion on Amputations and their Relation to the Artificial Limb

ROYAL MICROSCOPICAL SOCIETY (Biological Section).

THURSDAY, APRIL 3

INSTITUTION OF CHEMICAL ENGINEERS (Annual Corporate Meeting) (at St Ermins Westminster), at 3 —Dr J T Dunn and Dr B Moore Pulverised Fuel

LINNEAN SOCIETY, at 5 —H Lister Some Observations on the Comparative Morphology of the Protozoan Fauna, etc —Prof H S Holden Some Wound Reactions in *Ankyropteris corrugata* —Dr J M Cowan Botanical Exploration through North west Persia

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Prof J B. S Haldane Some Problems of Genetics

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts) at 6 30 —P Grimault Operation of the Aero-Postale Service in Europe

CHEMICAL SOCIETY, at 8 —Prof C S Gibson, A. R. Penfold, and J L. Simonsen The Essential Oil of *Backhousia Angustifolia* Part II The Isolation of Naturally Occurring β diketones Angustione and Dehydro angustione —Miss F M Hamer Attempts to Prepare Cyanine Dyes from Quaternary Salts of 2 methylacenaphthpyridine and of methylacridine —Prof C S Gibson E S Hiscocks, J D A Johnson, and J L. Jones 10 Chloro 5 10 Dihydrophenarsazine and its Derivatives Part XII Absorption Spectra —R W Aldis and Prof J C Philip The Production of Fog in the Neutralisation of Alkali with Hydrogen Halides Part II The Significance of the Presence of Ammonia.

OPHTHALMOLOGICAL SOCIETY —Sir Arthur Keith The Genius of William Bowman (Bowman Lecture).

FRIDAY, APRIL 4

INSTITUTION OF CHEMICAL ENGINEERS (Annual Corporate Meeting) (at Hotel Victoria Northumberland Avenue), at 11 30 A M —Presentation of Medals The Moulton Medal, The Junior Moulton Medal, The Osborne Reynolds Medal —At 12 15 —J A Reavell The Rôle of Science in Industry (Presidential Address) —At 2 15 —H Tongue The High Pressure Equipment of the Chemical Research Laboratory, Teddington

ROYAL SOCIETY OF ARTS (Indian Section), at 4 30 —Lieut -Col Sir Wolseley Haig The Maratha Nation (Sir George Birdwood Memorial Lecture)

FEDERAL COUNCIL FOR CHEMISTRY (at Burlington House), at 4 30

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute Newcastle upon Tyne), at 6 —A. Read Ship's Electrical Deck Auxiliaries

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (Annual Meeting) (at Chamber of Commerce, Birmingham), at 6 30 —At 7 —A. R Warnes Some Little Known Causes of Stone Decay

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (Annual General Meeting) (at Engineers Club, Manchester), at 7 —Major A. G Church The Attitude of the Government towards Scientific Research

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7 —Dr E H Rayner W G Standring, R. Davis, and G W Bowdler Studies in Low Power Factor Measurements at High Voltages

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7 —A L Stanton and others Discussion on Smoke.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7 —Informal Meeting

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7 30 —W M Hurrell Visits to Iceland and other Places

GEOLOGISTS' ASSOCIATION (at University College), at 7 30 —A. L. Leach Geological Structure and British Coastal Scenery (Lecture).—A L Leach and A C Young On a Section in River Ravensbourne Valley Gravels at Lewisham.—A. L Leach Recent Excavations in the Shooters Hill Gravel.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (Annual Meeting) (at Liverpool University).—A. H. Amery Methods of Extracting Oil from Seed

SATURDAY, APRIL 5

GILBERT WHITE FELLOWSHIP (Annual General Meeting) (at 6 Queen Square, W C 1), at 2 30 —At 3 —Sir Richard Gregory Primitive Astronomy (Lecture).

MINING INSTITUTE OF SCOTLAND (at Glasgow).—Annual Meeting.

PUBLIC LECTURE.

SATURDAY, MARCH 29

HORNIMAN MUSEUM (Forest Hill), at 3.30.—J E. Dallas June Flowers in Alpine France.

SATURDAY, APRIL 5, 1930.

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The Rationalisation of Chemists

THOUGHTFUL men and women, surveying the part that science has played in the lives of the present generation, have no illusions concerning its potency, for good or for ill, in controlling the destiny of their successors To have seen science in the grip of Mars, to have watched the wonderful service of chemistry to medicine, is to know how true it is that knowledge applied is power acquired, those who have lived through a clash of arms in which science, whether acknowledged or not, dominated policy, strategy, and tactics, find no difficulty in applying, indeed they are constrained to apply, that same experience to the problems of the post War world In the industrial troubles of to-day—depression, loss of overseas markets, unemployment—they recognise inevitable casualties in the battle of industrial wits, and they know that the struggle must end in favour of the best equipped battalions, if they did not know it before, they realise now the truly vital position of the scientific basis of industry in the nation's life Once again science will dominate policy, strategy, and tactics, and in the intense industrial competition, over the threshold of which we have yet scarcely stepped, tradition will count for little beside knowledge, and pride for nothing compared with progress

What will in the future be the foundation of our national wealth and influence? Not conquest, nor colonisation, our position will depend on the use to which we put our heritage of natural resources Of the basic industries of Great Britain, three—mining, metallurgical, and chemical—are of prime importance These stand sentinel over our future prosperity, it is to these industries, aided at almost every step by engineering, and drawing frequently, as occasion requires, on the resources of knowledge gathered by almost every other science, that we turn for means to exploit our potential wealth The nation which fails to organise its industrial power will scarcely expect to reap commercial rewards, and the nation which fails to employ methods at least as efficient as those of its competitors will have to go out of business

Chemists and chemical engineers have long been considering the position On the commercial side we have seen important amalgamations effected in order to promote efficiency and economy of effort On the scientific side much advance but little reorganisation has yet taken place, although the need grows with the expansion of chemical knowledge and influence Nevertheless, British chemists fully

realise the responsibility of the position occupied by their profession, and whilst they subscribe wholeheartedly to a policy of international fraternity among scientific workers, they are neither unaware nor careless of their own country's needs They are anxious, therefore, to modernise professional machinery in the chemical group of sciences for more effective industrial defence and more rapid progress They desire to put their house in order by eliminating duplicate provision and effort, and thereby consolidating the personnel of the nation's chemical service

Now chemistry, as is well known, instead of remaining a homogeneous unit in the scientific corpus, has almost acquired the status of a sub-group of sciences Since the foundation of the Chemical Society, the first organisation in the world to be established for the special purpose of promoting chemical knowledge, there have grown up various societies of chemists and chemical engineers who concentrate their attention on different branches of the science—how different, chemists alone know! Each plays a worthy part in promoting discovery and application, and any scheme of co-ordination will necessarily have in view the intensification, and not the delimitation, of studies in every field In order that the ground may be more thoroughly surveyed, and to conserve the limited resources of a profession which, on the whole, is in receipt of only a modest competence, Prof J F Thorpe, in his recent presidential address to the Chemical Society, has outlined definite and considered proposals which merit the most careful consideration by the interests concerned A firm believer in co-operation in science and industry, Prof Thorpe seeks to put into practice his principles What appears an impossibly heavy task for the chemical group unaided may become possible by association with other branches of science Hence he proposes to solve the housing problem by co-operation with societies in the mining and metallurgical branches, and to promote co ordination of effort in the chemical branch by fusion of publications and, eventually, of membership

This twofold scheme seems to us to provide at least a firm basis for action. The proposals, by seeking to establish a kind of chemical 'general headquarters' forming a unit in an even more comprehensive scientific and industrial assembly, are thereby invested with an importance which is not only national, but also imperial Many of the principal societies for encouraging the acquisition, marshalling, and dissemination of scientific knowledge, not least those concerned with pure and applied chemistry, are at present restricted in their usefulness by being inconveniently and inadequately housed, libraries are scattered, there is no general information bureau, even meeting rooms have to be borrowed and lent, there is little social intercourse between members of the same branch and less between members of different branches, office organisations are not in close touch—in short, there is lamentable lack, as regards accommodation, of the elementary needs of inter-group efficiency Efforts to remedy the situation have been discussed for the past ten years, but proposals have hitherto been rendered nugatory by the financial burden proving too oppressive for societies supported in so large a measure by the annual subscriptions of their members Even under present conditions the Chemical Society, for example, by the exercise of rigorous economy, finds it only just possible to show a small credit balance when provision has been made for the cost of the publications, which is the chief expenditure

Accommodation and co-operation, then, are the needs to be supplied The joint housing project involves only half the capital expenditure previously envisaged, and it has the merit of securing real co-operation with the minimum disturbance of the constitutions and functions of the participating societies, whilst it will facilitate fusion should this course commend itself at some future time A scheme originating with the mining and metallurgical societies and institutions provided the nucleus of the wider project, which now proposes to secure collaboration by the Empire Council of Mining and Metallurgical Institutions, the Institution of Mining and Metallurgy, the Institution of Mining Engineers, the Iron and Steel Institute, the Institution of Petroleum Technologists, the Institute of Metals, the Institute of Fuel, the Chemical Society, the Society of Chemical Industry, the Institution of Chemical Engineers, and the Institute of the Rubber Industry in seeking financial assistance for the erection of a suitable building to serve as a joint headquarters in Westminster Two-fifths of the space, a veritable 'Chemistry House', would be allotted to the chemical group, and their share of the capital sum involved would be £140,000 In so far as the accommodation then available would not be required for immediate occupation by the participating societies, it would be used by 'tenant' societies directly connected with the industries represented by the constituent bodies The Chemical Society's library would form the nucleus of the new library whilst continuing to function, as at present, as a sectional library. The central library is, of

course, one of the pivots of the whole scheme, as also is the proposed bureau of information

Prof Thorpe fully realises that the problem of raising the necessary money is difficult, particularly in view of the present great depression in industry and the incidence of high taxation He naturally and properly looks, however, to the chief ultimate beneficiaries, namely, the industries concerned, to afford the greater part of the required support As chairman of the appeal committee, he finds among those engaged in industry an eagerness to play a worthy part , of the total sum of £350,000 required, definite promises amounting to £130,000 have been received This is an encouragingly large sum, but encouragement is tempered with anxiety in respect of the remaining £220,000 The Government has, we understand, expressed sympathy with the object in view, but has refused—we hope not finally—to accord any financial assistance

Such is the outline of the important proposals which affect more than twenty thousand of our colleagues Before we turn to the second group of proposals, we would offer one or two observations on this solution of the ' housing problem ' In the first place, we consider the scheme to be conceived in the interests both of science and of the nation, so that we unhesitatingly and whole heartedly support it in principle Whilst we are not willing at this stage to comment on matters of organisation or of detail, matters which will assuredly exercise the leaders of the professions concerned for some time to come, we think the proposals are likely to be effective in their purpose without causing unnecessary disturbance of existing institutions , they have the merit of envisaging more than they are intended immediately to accomplish, and they promise to serve the community Scientific workers obviously cannot themselves bear the whole financial burden incidental to their public service, and we rejoice that industry is found willing to share it with them We invite industrialists to sow with a liberal hand that seed of which they will in due time enjoy the fruit , times are hard, but this is an additional reason for helping to consolidate the ranks of their willing, indeed eager, servants

The attitude adopted by H M Government is, we hope, one which will prove amenable to modification on reflection Some consideration is obviously due, and will presumably be accorded, to the Chemical Society in respect of the surrender of its free tenancy of rooms at Burlington House. In any event, it could scarcely represent the extent of the public interest in the scheme Public money should be expended for the ultimate good of the public as a whole, and in our opinion the scheme which Prof Thorpe has outlined is one which both deserves and demands substantial support from the public treasury We should not like to think that, in its attitude towards the organisation of science for the service of industry, any government of the present day believes that its responsibility can be discharged by merely recording its approval

While rightly insisting on the service which science renders to the growth of industry, Prof Thorpe does not, of course, forget that which industry renders to the advancement of so called 'pure' science He quoted in illustration the certainty of advance in organic chemistry which is associated with the existence in any country of a successful and well-established dyestuffs industry Large research organisations created by firms employing many of the most capable chemists in Great Britain promote progress in directions which are not confined to the special needs of the industry itself, but equally serve other related interests

The further proposals which Prof Thorpe puts forward are concerned with the publications of the Chemical Society and the Society of Chemical Industry and with a plan for joint membership It is suggested that joint publication of four journals, in addition to the annual reports, should be undertaken chemical transactions (monthly), abstracts (A and B together), a publication similar to the American *Industrial and Engineering Chemistry* (monthly), and *Chemistry and Industry*—the news edition (weekly) There are obvious advantages to be secured from such unification, and the proposal merits careful exploration Six years' successful work by the Bureau of Chemical Abstracts, itself a joint board, has shown that co operation in publication is both possible and advantageous, and there are many who look forward to the possibility of extension of the principle Moreover, it is believed that it could be made financially possible for each section of the Society gradually to secure a membership common to both, while preserving financial and administrative autonomy

Granted that ultimate fusion of the two societies is desirable, Prof Thorpe's suggestions reflect practical statesmanship and something more than a superficial knowledge of human nature Whether or not they prove acceptable to chemists without modification, he has performed a substantial service in so carefully exploring the position and in providing a promising basis for discussion The opportunity for action appears to have arrived , chemists will be well advised not to allow it to pass Many years may elapse before it recurs

The Gramophone

Modern Gramophones and Electrical Reproducers By P Wilson and G W Webb Pp xvi + 272 + 12 plates (London, Toronto, Melbourne and Sydney Cassell and Co, Ltd, 1929) 10s 6d net

THE recent development of the gramophone has presented a striking example of the great benefits to be derived when industrial research can be directed upon the basic *phenomena* of an industry Sufficient co-operation between manufacturers cannot always be secured to finance such comprehensive research, and then little more can be undertaken than an initial quantitative definition of industrial *processes*, as distinct from the natural phenomena underlying them, and a subsequent study of empirical changes made in these quantities For a period of some twenty five years, gramophone research was purely empirical and the meagre results gave only a product which the establishment of broadcasting threatened to exterminate Then the whole gramophone industry was suddenly revitalised by the introduction of electrical recording and the matched impedance type of reproducer The present volume deals more especially with these remarkable advances, all of which originated in the Bell Telephone Laboratories in New York and, we would emphasise, were merely by products of an enormous fundamental research

To know their origin, which happened to lie in practical telephone designing, lends a deeper significance to the book Some fifteen years ago, an advanced stage had been reached in the art of accurately analysing fluctuating electrical currents into their component frequencies and in the correlated art of describing and measuring the characteristics of mechanically vibrating systems A part of telephone design was, however, empirical, because speech and hearing could not then be defined quantitatively in physical terms At this stage the step was taken which ten years later yielded results of such importance to the gramophone It was decided to attempt a quantitative definition of speech and hearing Now, although the ear is so delicate, it is so accommodating that its use as a measuring instrument is quite invalid and apparatus of remarkable precision had to be developed Since this apparatus proved to be costly and often complicated and difficult to adjust, it appeared to be of interest only in the research laboratory Nevertheless, one of the instruments, an electrical transmitter developed in the early stages of the research, is now used to produce the modern gramophone record

At the beginning of the book, there is an excellent discussion of the requirements for perfect reproduction A statement by a music critic is worth quoting "When I sit in an acoustically perfect hall (full of people), in the best seat for hearing, and listen to an orchestra, I hear such and such sounds I want to hear precisely this effect from a record" From this simple statement, the dependence of the problems of gramophone reproduction not only upon acoustical, but also upon psychological and physiological considerations, is clearly evident The acoustical and other physical problems occupy the greater part of the volume, although some of the vagaries of the human ear are described

The functions of all the separate parts of the gramophone, consisting of needle, stylus-bar, diaphragm, sound box, tone arm, and horn, are now well understood, and it is interesting to note that of all the readily conceivable forms which a sound-box might have taken, the one which was developed happens to correspond closely with that which modern theory shows to be desirable This theory of the design of the whole system from the needle-point to the mouth of the horn has been developed on the lines of the new electro mechanical acoustics, which utilises the analogies between electrical circuits and mechanical systems Practice lags behind theory because of the difficulties of providing and measuring the constants of some of the required mechanical analogues For example, a condenser can be made having large capacity with negligibly small inductance, but it is difficult to make the corresponding spring having compliance without inertia

From the interesting results given in the discussion of the horn, it is clear that for satisfactory reproduction of low notes the horn must be long and must end in a wide opening For example, the horn used in the 'Movietone' reproducer is 14 ft long, and has a mouth of about 5 ft diameter in order to get a sensibly uniform frequency response over the range from 60 to 7000 vibrations per second The alternative to the use of these long horns lies in electrical reproduction from the record with the aid of a moving-coil loud-speaker, and some seventy pages are devoted to the complicated problems of the pick-up and amplification So far as the realisation of theoretical requirements is concerned, the complete electrical gramophone appears to be less advanced than its acoustical rival There is no discussion of the problems of a sound film gramophone

The inclusion of a work on architectural acoustics in the bibliography of books, papers, and patent specifications, shows that the authors realise the importance of this subject, but no space is devoted in the text to its application in gramophone acoustics There is but little detail of the original wax record, and it would be of interest to know if data upon the physical properties of this wax and of the ordinary record material are available These are, however, comparatively minor points of omission

It is pleasant to find that this, the first serious book on the gramophone, is so well written and trustworthy that it has all the desirable properties of a standard work Since the book was written, still another ingenious application of electro mechanical analogies has resulted in the construction of a motor capable of rotating the original wax master record with remarkable constancy of speed, ensuring that the grooves in the record are even more faithful to the original sound (Elmer, *Bell Labs Record*, 7, 445 50, 1929)

W H George

Science and Philosophy

Philosophy by Way of the Sciences an Introductory Textbook By Prof Ray H Dotterer Pp xv + 469 (New York The Macmillan Co, 1929) 10s 6d net

THIS book well represents the remarkable change which has come over the study of philosophy within living memory People who studied philosophy at one of our universities thirty or forty years ago were almost invariably introduced to the subject on historical lines It was assumed that the best mode of approach to the problems of philosophy lay through the historical systems, beginning with the Greeks and ending perhaps with Kant and Hegel So far as Britain was concerned, it was a study most assiduously cultivated north of the Tweed, and when an English chair of philosophy became vacant, the list of applicants was bestrewn with the syllable 'Mac' Philosophy was regarded as a thing apart, an intellectual luxury, something of a holy mystery The philosopher's colleagues, especially those of the faculties of pure and applied science, were apt to regard his ministrations as harmless diversions, or as interesting attempts to solve problems which, unlike those of physics and biology, were in the nature of the case insoluble. It was all part and parcel of the general attitude of men of science, at a time when positive science was making astonishing progress, and seemed capable of leaving no problem ultimately unresolved

Gradually, however, a change has come over the scene, a change to which both sides have contributed Although, of course, the history of philosophical systems holds an important place in a certain type of university curriculum, yet it has become customary to introduce the student to the main philosophical problems as they appear to the modern mind, to show him what philosophy 'is all about', before plunging him into the history of the systems, and the advanced student becomes aware that the old puzzles have to be viewed in new lights, and that new puzzles have to be added to the old, under the impulse of the strenuous thought that is being devoted to philosophical issues in our time It would be easy to name a whole crop of books, produced since the beginning of the twentieth century, which exemplify these changes in the pursuit and the teaching of philosophy

Not less striking is the changed attitude of men of science, their modified faith in mechanistic explanations of life, and especially of the life of man, their consciousness that every line of scientific inquiry leads to problems which (using the word physics in its older and more general sense) are beyond physics, that is, are metaphysical Hence the present position, that some of our leading men of science are also among our leading philosophers

Dr Dotterer is, of course, not the first teacher to have led his students to approach "philosophy by way of the sciences" But we do not recall any introductory text-book which conducts its reader along this road so thoroughly and competently as the book under consideration Other writers are content to propound the problems of metaphysics, and incidentally to show that they begin where scientific explanation leaves off Dr Dotterer takes the bold course of devoting one half of his book to a survey of the sciences—what they have achieved, and where their difficulties begin A statement of the achievements of astronomy and geology is followed by a statement of the corresponding perplexities Is the world-process teleological? Is reality finite or infinite? What is the relation of time and space? And so on The achievements of physics, chemistry, and mathematics suggest perplexities about the constancy of our units, and the absoluteness or relativity of motion Similarly, the achievements of biology and psychology suggest perplexities about development, and the interrelations of mind and body. Not all his fellow

teachers would agree with the author's attempt to summarise the achievements of science, and some of them might charge him with an assumption of omniscience He took the risk, and all we can say is that we think he justifies himself

So the first half of Dr Dotterer's book leaves us with a somewhat bewildering bunch of 'perplexities', each of which presents a problem in philosophy Some of them are philosophical 'chestnuts', such as the issue between realism and nominalism Among the other problems are the criterion of truth, the problem of being, determinism and its opposite, the authority of values, and the belief in progress

Dr Dotterer has written primarily for students of philosophy, but he has aimed at producing something more than a text book, and in our judgment he has succeeded To make philosophical discussions clear to the general reader is not an easy task, but it is here accomplished The author writes lucidly and forcibly, and his criticism is always marked by modesty and sanity The general reader—and for the present purpose the student of science may be so described—will find this book a most useful introduction to the abstruse but ever alluring problems of metaphysical speculation

Bacteriology in Medicine

The Principles of Bacteriology and Immunology By Prof W W C Topley and Dr G S Wilson In 2 volumes Vol 1 Pp xvi + 587 + xvi Vol 2 Pp viii + 589 1300 + xx (London Edward Arnold and Co, 1929) 50s net

THE authors of this book say, "We have attempted on the basis of our personal experience in post graduate and undergraduate teaching to provide a text book which will be of service to those students of medicine and biology who wish to make a serious study of bacteriology, and its application to the problems of infection and resistance" This very desirable end has led them, we think wisely, to divide the book into two volumes, so as to treat in the first place the biological aspects of bacteria, and after that has been dealt with to pass to the subject of infection and the application of bacteriology to medicine and hygiene

Vol 1 is divided into two parts, the first of these deals with general bacteriology, and after giving a short, but interesting, historical outline, the authors proceed to the biological and physiological characteristics of bacteria—their growth and resistance to physical and chemical agents, serum reactions, bacterial variation, classification, and, finally, they give some practical details and a well-written chapter on the Twort d'Herelle phenomena

Though all these chapters bear evidence of wide reading and good critical judgment, we would specially praise the one on serum reactions and antigenic structure of bacteria This somewhat difficult and, at present, rather confused subject has been made clear to any intelligent reader, and the views of the various writers on this subject are given with great fairness The chapter on bacterial variation is also a very valuable one, and disinfection is treated very fully

The authors have thought it necessary to adopt the American classification This we feel is still crude and unsatisfactory, and we regret its adoption, though possibly if we had been the authors we would have been forced to do as they have done

Part 2 of the first volume concerns itself with the description of the various bacterial species This is well written, and the illustrations are, on the whole, very satisfactory We welcome the absence of detailed descriptions of technique which load up uselessly so many text books on bacteriology Why writers on bacteriology should give half a dozen or more different methods for staining a special bacterium has always been beyond our conception, and it is a joy to find a book where this is not done, and where the authors have deliberately omitted these

Vol 2 deals with bacteriology in its application to medicine and hygiene Part 1 deals with infection and resistance, and in a work of this kind for which Prof Topley has done so much one naturally expects a great deal We have not been disappointed The facts are very clearly put, and the critical work is of a high order Part 2 is very well done, and medical men dealing with any of the bacterial diseases will find valuable information on almost every page

We congratulate the authors on the production of an extremely valuable text-book, one which should find a place not only in every bacteriological and pathological laboratory but also on the bookshelf of every medical man The task must have been a very difficult one, for one must recognise that bacteriological literature is, at present, somewhat chaotic The authors must have read widely, but the strongest feature is the independence shown in departing from the usual text-book routine

J M. Beattie.

Our Bookshelf.

Index Londinensis to Illustrations of Flowering Plants, Ferns and Fern Allies Being an emended and enlarged edition continued up to the end of the year 1920 of Pritzel's Alphabetical Register of Representations of Flowering Plants and Ferns, compiled from Botanical and Horticultural Publications of the XVIIIth and XIXth Centuries Prepared under the Auspices of the Royal Horticultural Society of London at the Royal Botanic Gardens, Kew, by O Stapf Vol 2 Pp iv + 548 (Oxford Clarendon Press, London Oxford University Press, 1930) 105*s* net

In October 1929 the first volume of this important work made its appearance It included all plants from *Aa* to *Campanopsis* The editor, Dr Stapf, and his collaborators have now brought their great task one stage further with the issue of Vol 2, which appeared about Christmas 1929, but is dated 1930 It consists of 548 pages and is, therefore, of almost exactly the same size as Vol 1 It comprises references to illustrations of all plants from *Campanula* to *Dysphania* inclusive The Clarendon Press is once more to be congratulated on the excellence of the printing

The work is recognised by very many as one of great utility and a trustworthy and voluminous guide to all who desire to see pictures of plants or parts of plants belonging to the groups cited in the title It should, in this respect, supply every need of the practical gardener, be he florist or arboriculturist, and of the botanist, whether he be systematist, morphologist, or dilettante collector The work will help to direct attention to a good deal of the older literature which has been neglected in the past and frequently contains much that is valuable It will be found to fill many a gap caused by the omission of pictures of intrinsic merit in themselves, but which, for one reason or another, have been entirely left on one side by botanical workers It should also point the way to a proper discrimination in the choice of illustrations in the future

Another important function of the "Index" consists in the revision of the nomenclature of well known large genera such as *Bignonia*, *Croton*, *Pinus*, etc, which hitherto have included a confused medley of plants which, according to modern ideas, should be placed in quite distinct genera

This revision, let us hope, may have some effect in inducing gardeners to name their plants more correctly W C W

Handbuch der biologischen Arbeitsmethoden Herausgegeben von Prof Dr Emil Abderhalden Lieferung 307 Abt 9 *Methoden der Erforschung der Leistungen des tierischen Organismus*, Teil 6, Heft 1 *Methoden der Meeresfischereibiologie Die Methodik fischereibiologischer Untersuchungen an Meeresfischen* Von Adolf Büchmann Pp 194 (Berlin und Wien Urban und Schwarzenberg, 1929) 11 gold marks

To those who may wish to acquire a working knowledge of the methods employed in modern scientific investigations of the sea fisheries, this section of Abderhalden's great 'handbook' can be recommended When considering the subject, it should be remembered that the fisheries biologist is largely dependent upon data derived from relatively small samples for his knowledge of the fish population he studies It should therefore occasion no surprise that great use is made of statistical methods to determine the limitations of the samples taken, and hence to estimate the probability that the samples truly represent the population or stock from which they are taken Indeed, much of the most valuable work accomplished in recent years has been the development of trustworthy technique based on random sampling It cannot be too strongly emphasised that in this field of biological investigation, where results are to be applied to the great problems created by the commercial fisheries, nothing less than critical mathematical analysis can suffice This being so, it follows that the would be research worker will do well to include in his preparation the essentials of statistical treatment of raw data Dr Buchmann's treatise should prove most helpful in indicating the nature of the difficulties lying ahead

The Great Mathematicians By Prof H W Turnbull (The Great Scientists Series) Pp viii + 128 (London Methuen and Co, Ltd, 1929) 2*s* 6*d*

This little volume—one of a series devoted to the history of science—gives, in a very readable manner, an interesting narrative of some of the greatest representative mathematicians from the early Egyptians to Ramanujan In the preface, the author says "Fully conscious of the difficulties of the undertaking, I have written this little book in the hope that it will reveal something of the spirit of mathematics without unduly burdening the reader with its intricate symbolism" Herein lies the key to the whole story, for not only has the subject matter been very judiciously selected, but also the way in which it has been woven into a very human narrative is indeed an outstanding feature

Undoubtedly, in his brief delineation of those great personalities who found in mathematics both an inspiration and a delight, Prof Turnbull has very successfully achieved his purpose, and in so doing has rendered a real service to the popular development of so abstract a subject As the historical account is naturally incomplete, owing to the small size of the volume, a list of books for further reading is given

A Textbook of Light By Dr R Wallace Stewart and Prof John Satterly (The Tutorial Physics, Vol 3) Sixth edition Pp vii + 363 (London University Tutorial Press, Ltd, 1929) 6*s* 6*d*

This popular text-book, designed to carry the student to university intermediate stage, has now reached its sixth edition, in which the type has been re-set and certain sections have been re-written and simplified The opportunity has also been taken to add new matter to the chapter on dispersion, which serves both to offer a pleasant approach to the study of spectroscopy and to provide clear explanations of many common phenomena, such as lunar haloes, which are not always treated well in text-books

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

Quantitative Analysis by X-Rays

WE have read with much interest Prof Hevesy's address to the British Association on "Quantitative Chemical Analysis by X rays and its Applications" (NATURE, **124**, 841, 1929) While we are in agreement with many of the statements of that address, our experiments lead us to somewhat different conclusions as to the possibilities and limitations of analysis by X-rays

Qualitative Analyses —The simplicity of the X ray spectrum of an element (particularly of its *K* series), the existence of Moseley's law, the known facts relating to the relative intensities of spectral lines and to the potential required to excite a group of lines, make the X ray spectrum of any substance a comparatively simple one, and give to the identification of the lines a high degree of certainty It is true, however, that the experimental difficulties of producing such a spectrum and of measuring the wave length and intensity of the lines are not inconsiderable

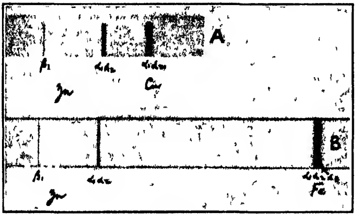

FIG 1

Prof Hevesy discusses the important question of the excitation of the X ray spectrum of the material being analysed This is all important to the practical convenience, to the sensitiveness, and to the quantitative accuracy of X ray analysis Three methods of excitation can be used In the first the material is bombarded in the vacuum of the X ray tube by cathode rays, in the second by Lenard rays outside the vacuum, and in the third, used by Prof Hevesy, by primary X rays which fall on the material either inside or outside the X ray tube

The first method involves all the difficulties of high vacuum technique, and is unsuitable for volatile substances A discussion of these methods cannot be given here, beyond noting that the second method has the important advantage of producing a characteristic spectrum free from general radiation It may be noted, too, that the metals and their alloys lend themselves to the first method, and when water cooled can be subjected to intense cathode ray bombardment The production of a strong beam of X-rays from a non-metal is, however, much more difficult

Prof. Hevesy refers to the sensitivities of analysis by X rays, and to the relative advantages of the optical and X ray methods of spectroscopic analysis, but it is not clear whether his remarks refer to quantitative or qualitative analysis In the detection of a small quantity of a given element in a mixture of elements by X-ray spectroscopy, a much higher degree of sensitiveness can be obtained than Prof Hevesy and other writers on this question have claimed

Fig 1, A, reproduced from a paper by the writers and Mr A H Turner (*Proc Roy Soc*, **124**, 258, 1929), shows the *K* spectrum of a zinc containing 7 parts in 10^6 of copper, and B shows the *K* lines of a zinc containing 3 in 10^6 of iron It is evident that 1 in 10^6, possibly 1 in 10^7, of iron in zinc could have been detected The detection of small amounts of impurities in non metals (usually examined in the form of powders) is more difficult than in metals, as faint lines may be masked by a dark background of continuous radiation from the metal upon which the powder is placed, and by scattered radiation It is, therefore, desirable to use as this metal one of low atomic number (for example, aluminium), and to select a voltage such that the wave length of maximum energy in the continuous spectrum does not coincide with that of the spectral line sought The photographic film must be protected from scattered radiation by suitable screens

Several quantitative methods of analysis by optical spectroscopy are in use One due to Lockyer depends on the variation in the length of certain lines in the arc and spark spectra of an element with the amount of the element present, another, due to Hartley, relies on the persistence of certain lines in the spark spectra of solutions when the element giving the line is present only in very small amount, while the third, and most successful, is based on the discovery of de Gramont that each element has several sensitive lines, or 'raies ultimes', which reveal its presence, in some cases, for so little of it as 1 part in 100,000 The amount of the element present can be determined with fair accuracy by the number of its lines which can be observed Unfortunately, however, for many elements all the lines vanish for concentrations of less than 1 in 10,000, and a further difficulty with a mixture of elements is the masking of the sensitive lines of one element by the strong lines of another

With the X ray method, the entire spectrum of an element persists even for amounts less than 0 0001 per cent, and thus the difficulty of identifying its lines does not increase for small concentrations to the same extent as it does for the optical spectra

Quantitative X Ray Analysis —Profs Coster and Hevesy, incidental to their discovery of the element hafnium, were the first to develop a quantitative method of X ray analysis They determined the amount of that element in a number of minerals by an empirical method in which tantalum was added to a mineral until in the spectrum of the mixture the tantalum $L\alpha_1$ line ($\lambda = 1\ 518$ A) gave the same blackening on the photographic plate as the hafnium $L\alpha_1$ line ($\lambda = 1\ 566$ A) The amount of hafnium present was taken to be equal to the amount of tantalum added

In a paper which is being published in the *Proceedings of the Royal Society*, we have described a quantitative method which gives the ratio of the amounts of the two elements present in an alloy for a wide range of values of the ratio This method is not restricted, as is that of Coster and Hevesy, to discovering when

the elements are present in equal amount, and no addition of an element to the substance to be analysed needs to be made The assumption is made that, for an alloy of two elements of nearly equal atomic number, the ratio of the number of the atoms of the two elements present is equal to the ratio of the intensities of corresponding lines (say the $K\,\alpha_1$ lines) in the spectrum of the alloy, provided these lines are excited under equivalent conditions The X ray line intensities are determined photographically by photo metering the lines, and by determining the X ray Hurter and Driffield curve of the emulsion used The determination of line intensities in this way is found to be both convenient and accurate The assumption mentioned has been verified to a quite satisfactory degree of accuracy by making an X ray analysis of the following six alloys of known composition

Cu 73 per cent, Zn 27 per cent, Cu 1 1, Zn 98 9, Cu 0 11, Zn 99 89, Sn 71, Cd 29, Pb 60 5, Bi 39 5, and 12 per cent Zn in Zn-Sn Cu

The alloys used included both heterogeneous and homogeneous structures, and in some cases the K series was used, in others the L series

Our observations are not in agreement with those of previous workers in respect to the effect of a third element, an effect referred to by Prof Hevesy Coster and Nishina found that the presence of a third element in a powder mixture affected the accuracy of their results in cases when no selective absorption took place, and they concluded that the same method as we have used was not accurate For alloys, however, we find it quite accurate

T H LABY
C E EDDY

Natural Philosophy Laboratory,
University of Melbourne,
Feb 5

Nature of the Magnetisation Curve of Single Iron Crystals.

IN recent years various observers have investigated the magnetisation of single iron crystals Their results differ in several important respects From investigations of iron crystals made in these laboratories, we believe that the observed differences are ascribable mainly to the unsatisfactory accuracy with which magnetic field intensity has been estimated when the demagnetisation factor is very large, or when it is a function of the magnetisation, as it is in specimens that are not ellipsoids In the latter case, the only way in which the field intensity can be determined is by direct measurement Experimenters, strangely enough, have seldom employed this procedure, preferring rather to rely on calculation of the demagnetising component of the field intensity by methods which have been shown to rest on invalid assumptions

The outstanding problem evoked by these discrepant observations is the question of whether or not there are 'breaks' (abrupt changes of slope) in the magnetisation curves and hysteresis loops The existence of this phenomenon was announced by W Gerlach (*Phys Zeits*, **26**, 914, 1925) four years ago. Since then its reality has been repeatedly confirmed or denied by other observers

We believe that the breaks appearing in these curves are spurious, and that in the few cases where it is not possible to draw a smooth curve fitting the points equally well, they are due to incorrect estimation of the field intensities In support of this idea we offer the following facts:

When a sufficient number of points on the curve are obtained and the *actual* magnetising field—the applied field less the demagnetising component—is *measured* with considerable accuracy, the magnetisation curve has no breaks (Foster, *Phys Rev*, **33**, 1071, 1929) If, however, these same data are plotted *without* applying the measured field intensity corrections, curves are obtained which in most cases are so flattened at the knee that it is possible to construct that portion of the curve with one or two sharp changes of slope The reason for this is that the demagnetising component of the field intensity usually goes through a rather sharp maximum in the same range of magnetisation as is occupied by the knee of the curve This maximum is always present in uniform cylinders In iron crystals the curve of demagnetising component vs magnetisation, or 'correction curve', is unlike that for ordinary iron, and is similar in shape to that obtained in poly crystalline permalloy (Foster, *Phil Mag*, **8**, 312, 1929) In no case is this correction curve the familiar straight line ('shearing curve') which has been so generally assumed

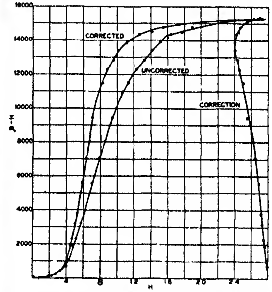

FIG 1 —Magnetisation curve of an iron crystal showing the characteristic correction curve and the effect of omitting it

There have been three other researches in which the intensity of the actual magnetising field was measured In two cases (Dussler and Gerlach, *Zeits f Physik*, **44**, 279, 1927, Gries and Esser, *Archiv f Elektrotech*, **22**, 145, 1929) the authors show curves with breaks, but there are not enough points in the region in question to justify them In the third (Wolman, *Archiv f Elektrotech*, **19**, 385, 1928) the published curves are smooth Sizoo (*Zeits f Physik*, **56**, 649, 1929), whose specimens were cylinders with rounded ends, regards the fact that his uncorrected curve is broken as proof that the true curve must be regarded as a broken one Our determination of the actual field corrections for cylindrical iron crystals indicates that only the uncorrected curve is flattened at the knee The explanation of the breaks is illustrated in Fig 1

DONALD FOSTER
RICHARD M BOZORTH

Bell Telephone Laboratories,
New York, N Y,
Jan 15

Atmospheric Light Columns from Artificial Lights.

Brilliant beams of light, appearing to go upwards vertically from street lamps and electric signs, are seen here frequently during the winter months The accompanying photograph (Fig 1), taken on the evening of Feb 4, shows a typical case

The beams are seen only when the air is filled with snow or ice crystals These apparently act as reflectors, since the beams from neon signs show the same colour red as the source itself Examination of the beams through a Nicol prism indicates that they are unpolarised

An exceptional case was observed on the evening of Jan 3 A powerful electric sign showed four beams in addition to the vertical beam Two of

Fig 1

these were horizontal, while the other two were inclined at an angle of about 45° with the horizontal The horizontal beams were apparently of the same intensity as the vertical beam The inclined beams were just visible

Up to the present I have been unable to find a mention of this phenomena in the literature on the subject, or to suggest a reasonable explanation

B W Currie
University of Saskatchewan,
Saskatoon, Sask, Feb. 8

Light columns over artificial lights have been described previously, but Mr Currie appears to be the first to photograph the phenomenon

The columns can be explained in the same way as sun pillars Mr Currie suggests that the light is reflected from the surfaces of ice crystals We may add that to produce vertical columns the reflecting surfaces must be nearly horizontal The effective crystals are probably laminar A flat disc falling slowly through the air keeps nearly horizontal.

In the explanation of the sun pillar, stress has to be laid on the fact that the falling disc will wobble or even spin so that the reflecting surfaces are not strictly horizontal and the pillar is analogous to the streak of light produced by reflection from rippled water Columns such as are shown in Fig 1 might be due, however, to reflection from strictly horizontal surfaces at different heights in the atmosphere The elevation of the tallest of the columns may be estimated at about 12° If the source of this light was a mile from the camera, reflection from a horizontal surface at a height of 500 feet would serve to produce rays coming down at that angle. The narrowness of the beams is in favour of this view of the phenomenon

As to the exceptional observation of Jan 3, it is likely that crystals of two types were present, laminar crystals were responsible for the vertical column On the analogy of the mock sun ring, the horizontal beams must have been due to the reflection of light from the faces of prisms floating with their axes vertical Two reasons for the assumption of this position are known Either the crystals contain air bubbles or they have flat crystals attached to them to serve as parachutes The latter explanation is the more likely in the present instance, for flat crystals were certainly present, and it is known that prisms can grow on the under sides of flat crystals

The beams inclined at 45° have no analogue in daylight observations Such beams might be due to light reflected twice, once at a vertical surface and once at a horizontal surface

The growth of brilliant illumination in the cities of the north will provide an opportunity for the observation of various other phenomena If an artificial mock-sun ring can be seen, the mock suns themselves should be looked for as well as the circular halo Mr Currie is to be congratulated on his pioneer work in this field The suggestion may be added that when possible the *forms* of the crystals should be recorded as well as the optical phenomena attributed to their presence

F J W Whipple
Kew Observatory,
Feb 26

The Heat of Dissociation of Oxygen and of the C-H Bond.

In a short notice in *Die Naturwissenschaften*, Dec 20, 1929, I published a new method of determining the heat of dissociation of oxygen (128 kcal), comparing the spectroscopical dissociation of nitrogen peroxide with the thermal decomposition according to the scheme

$$\begin{array}{ll} \text{Photochemical} & NO_2 = NO + O - 77 \text{ kcal } (\lambda 3700) \\ \text{Thermal} & NO_2 = NO + \tfrac{1}{2}O_2 - 13 \text{ kcal} \end{array}$$

In a letter in Nature of Feb 8, p 202, Prof. V Henri has calculated—using exactly the same method and values adopted by me in my note—this heat of dissociation, and arrives, of course, at exactly the same value of 128 kcal It should be stated here that my computation of the dissociation energy was based not only on the fine work of Norrish on the photochemical decomposition of nitrogen peroxide but also on my own spectroscopical investigations of the absorption spectrum of this molecule. I found that predissociation took place between λ3700 and λ3800 A A full account of this new method of determining spectroscopically heats of dissociation was given at the meeting of the Physikalische Gesellschaft at Kreuznach on Nov. 23, 1929, and will be published in *Zeits f phys Chemie* (B)

I would especially wish to emphasise here that my method may readily be extended to other problems. From the thermal decomposition of ozone according to the analogous scheme

$$\begin{array}{ll} \text{Photochemical} & O_3 = O_2 + O - 30 \text{ kcal. } (\lambda 9500) \\ \text{Thermal} & O_3 = O_2 + \tfrac{1}{2}O_2 + 34 \text{ kcal.} \end{array}$$

it follows that photochemical decomposition should start at about λ9500 if the dissociation products are normal O_2 and normal O, or at about λ4100 or less, if some excited molecule or atom is the end product.

On the other hand, the photochemical formation of ozone will start first at λ2200, since the existence of oxygen atoms is required for this reaction Decomposition of ozone was found at λ6000 (Kistiakowski) and λ4360 (Bonhoeffer) and formation at λ2070 (Warburg) in agreement with the above statement

In the same way the energies of different C H bonds in hydrocarbon compounds might be determined, for example (formaldehyde)

Photochemical	$H_2CO = HCO + H - 107$ kcal	(Predissociation at λ2670)
Thermal	$H_2CO = CO + H_2 - 2$	(calc from heat of combustion)
	$H_2 = 2H - 101$	
	$HCO = CO + H + 4$ kcal (!)	

The energy of the C H bond in formaldehyde is 107 kcal (acetaldehyde 93 kcal, benzaldehyde 110 kcal — predissociation at λ3050 and λ2550 according to V Henri and S A Schou) Therefore it requires 111 kcal to excite normal (bivalent) carbon monoxide to the tetravalent $=C=O$ molecule, which is responsible for the reaction The same value is obtained from the dissociation of carbon dioxide The energy of the CO bond, derived from spectroscopical data, is about 240 kcal (not very accurately known), whilst the decomposition of carbon dioxide into normal carbon monoxide and oxygen requires only 130 kcal, so that the excitation energy is about 110 kcal

Assuming this value, derived independently from two reactions, to be correct, one is able to calculate the energy of the CH bond in methane to be 115 kcal and that of the C C bond in different hydrocarbon compounds to be 110 115 kcal, compared with the old values of 90 kcal (CH) and 65 kcal (C C) The energies of the $C=C$ and $C\equiv C$ bonds come out to be about 200 and 300 kcal

R Mecke

Physikalisches Institut, Bonn,
Feb 28

Sex in Fungi.

In their letter in Nature of Mar 1, Prof R Ruggles Gates and D V Daran appear to welcome the new views on heterothallism in the fungi, such as Dame Helen Gwynne Vaughan's conception of nutritive heterothallism, which have come in, as they say, "to relieve the tension on the earlier rigid hypothesis of fixed + and − strains corresponding respectively to the female and the male sex"

It is only fair to point out that Dame Helen Gwynne-Vaughan and her colleague, Mrs H S Williamson, only put forward this suggestion of nutritive heterothallism tentatively and frankly admit that "we have not yet been able to justify this term"

To interpret the various forms of heterothallism found in the fungi, the facts discovered in recent years must be fully realised Sex heterothallism is only one of several forms of heterothallism, and it is perhaps due to the confusion between these various forms that the theory of multiple sexes has gained such a hold A much simpler and more workable hypothesis, as pointed out by Brunswik, is the conception of two sexes, the inter reactions between them being controlled by one or more factors other than sex factors These controlling factors are held by Kniep to be positive sex factors, by Brunswik to be negative sterility factors, and, as the latter also points out, the conception of one or more sterility factors eliminates the necessity (on the positive sex factor hypothesis) for the assumption of multiple allelomorphism (to the nth) to account for the complete fertility between geographical races, as found in some of the Coprini But a corollary must be added to Brunswik's hypothesis Since, in a number of cases of Coprini, all the mycelia of one fruiting body will show complete fertility towards all the mycelia of another fruiting body, the mycelia must be potentially bi sexual, although haploid, and the lack of fusion between certain given mycelia from the *same* fruiting body is due to the effect produced by one self sterility factor, or by certain given combinations of two self sterility factors

The work on *Humaria granulata* has thrown a flood of light on this problem Here we have a fungus in which the mono ascospore mycelia are to all appearances female, the first case of the kind to be recorded When grown singly the mycelia remain sterile, when combined with each other, half the combinations prove fertile The authors rightly point out that this is not sex heterothallism (haplo synœcism) If it is a case of nutritive heterothallism, then a further assumption has to be made, to explain the fact that only half the combinations are fertile

Thus two entirely new assumptions have to be made which only add to the complexity of heterothallism in the fungi of which Prof Gates and Mr Daran complain

The results, however, can be explained adequately in another way, without either of these assumptions, as follows

The mycelia must be self sterile, and although haploid must be potentially bi sexual They fall into two definite groups, in the ratio of 1 1, and the members of each group are sterile *inter se* This sterility can be explained on the basis of one self sterility factor *Aa* This factor and its allelomorph would segregate at meiosis in the ascus, so that half the spores would receive *A*, and the other half *a* As like will not fuse with like, mycelia carrying *A* will only fuse with *a*, and the only possible zygote is *Aa* On this assumption the mono ascospore mycelia from such a zygote would be of two kinds and would give 50 per cent of fertile combinations

This is not sex heterothallism but a form of physiological heterothallism based on one self sterility factor in a haplo synœcious fungus

The same interpretation might be applied to the heterothallic Hymonomycetes, haplo synœcism with one self sterility factor in the species showing bi polar segregation, and two self sterility factors in the quadri polar species

The results of the experiments on *Humaria granulata* tend to strengthen the evidence in favour of the conception of only two sexes in the fungi, and the occurrence of other factors which disturb their inter-reactions

With regard to the results of the experiments on the heterothallic *Mucor hiemalis* (a species showing true haplo heterœcism), it is not quite clear whether it is to be inferred that they bear upon the subject of nutritive heterothallism or not The striking morphological and physiological changes induced by subjecting the mycelia to adverse conditions are interesting, but although zygospore formation may be completely inhibited, there is no evidence of nutritive heterothallism, and the repulsion shown by the mycelia of both strains suggests some form of staling. Neither does the production of imperfect zygospores support this view, as the formation of abortive fruiting bodies is not uncommon in the heterothallic fungi In the Hymenomycetes, some strains are even capable of producing haploid fruiting bodies with viable spores, but these spores are all of the same sex (so called)

D M Cayley

John Innes Horticultural Institution,
Merton Park, S W 19, Mar. 6.

Projection of Long Spark upon the Yellow Spot of the Retina

The entopic vision of the fovea centralis by an instantaneous illumination, especially by blue light, may be well known to ophthalmologists The following observations, which were made during our physical experiments with long disruptive sparks of a characteristic type, may, however, be of some special interest

A fine straight spark of several centimetres may be produced between two spherical electrodes of 3 5 cm diameter which are continuously charged up by means of a Wommelsdorf machine with about 1 m capacity in parallel, provided that a needle point leakage is attached to the positive lead at a point not too near the spark gap With this arrangement the usual irregular bending of spark tracks is effectively avoided, and nearly straight long sparks may be drawn successively at regular intervals By projecting the magnified image of this spark on a ground glass screen by means of a proper photographic lens, we obtain a fine luminous line of considerable length and of extremely short duration, which appears at the same position of the screen in regular succession This constancy of spark track can only be obtained with the use of the needle above mentioned

It is this type of spark which is specially suited for the observation of the physiological effect here in question Place a blue filter glass in front of the photographic lens, or before the eye, and look at the image of the spark from a suitable distance Using a single eye adapted to darkness for a sufficient time, the part of the luminous line corresponding to the foveal region appears very dark and of saturated blue colour The dark segment seems to make a singular jerky motion, spreading out a little on both sides This motion can be seen better when a short segment of the spark is observed, screening off the remaining part by an opaque sheet On looking at a point on the immediate outside of one end of the luminous streak, luminosity seems to move towards the other end Some observers seem to perceive also a momentary contracting motion of the dark segment at the beginning or the end of the expanding motion

Outside the foveal region the luminosity appears to move towards the yellow spot This may be observed most effectively when the eye is fixed at a point outside one end of the long spark image

Another fact which may perhaps be of special interest is that when the image of the spark is thrown across the centre of the foveal region we may observe a pair of faint circular haloes on the two sides of the spark track The interior of the halo is quite dark and the two dark discs touch the spark as well as each other The screen was covered by a piece of cardboard with a slit slightly wider than the spark image, such that the faint illumination of the general background in the neighbourhood of the spark could be cut off The halo remained This is probably brought about by the propagation of excitation along the marginal part of the fovea centralis

With a yellow filter, the foveal part appears brighter than the external part and bounded by dark fringes

The experiments may be varied widely by altering the intensity and magnification of spark, the distance of the eye from the screen, the time interval of successive sparks, the time of adaptation of the eye to darkness, etc

The visual angle of the foveal dark segment was measured and found to be considerably different for two observers

Torahiko Terada
Institute of Physical and Chemical Research,
Tokyo

The Absorption Spectrum of Selenium Dioxide.

The fact that selenium dioxide, a white solid, gives a brown vapour has been discussed by Meyer and Langner (*Ber*, 60 B, 285, 1927), who conclude that the colour must be due to the dioxide and cannot be attributed to selenium liberated by dissociation

The absorption spectrum of selenium dioxide has been partially described in a brief note by E J Evans and G N Antonoff (*Astrophys Jour*, 34, 277, 1911), who, using 0 006 gm of the material in an evacuated tube at temperatures ranging from 360° to 900° C, observed absorption band heads from λλ3930 to 4470 A and, at the highest temperature, continuous absorption below λ4200 A But absorption in this region will not account for the brown colour of the vapour, which is observed, moreover, at temperatures of the order of 300° 400° C The spectrum has now been photographed in this laboratory on a Hilger E 1 quartz spectrograph and banded structure has been found to extend over a much wider range, namely, λλ3840 to 5740 A

Evans and Antonoff's result may be due to the selenium dioxide vapour in the tube not being saturated, and further to the fact that selenium dioxide dissociates rapidly *in vacuo* For this reason, in the present work excess of selenium dioxide was taken and the tube filled with oxygen at a pressure of half an atmosphere at room temperature before sealing off

The pyrex absorption tube was 1½ metres long and was heated electrically to temperatures ranging from 250° to 400° C according to the region of the spectrum it was desired to observe I am indebted to Mr T W Parker, of the Chemistry Department of this College, for a supply of freshly prepared selenium dioxide

In the near ultra violet and violet a regular series of diffuse heads is observed, some of which have an appearance of a very complex and fine structure The diffuseness may thus be due to insufficient resolving power In the blue green, green and yellow, the obvious regularity disappears, but there are a number of sharp heads, degraded to the red

This spectrum is presumably due to selenium dioxide, since saturated selenium vapour at a temperature of the order of 400° C, in a similar tube, was found to give no absorption in the region in question Evans and Antonoff obtained selenium absorption bands in this region, but at a higher temperature at 300° C, absorption was confined to the region λλ3200 3700 Further, when an evacuated absorption tube was used in the present work, the spectrum gradually disappeared owing to the dissociation of the selenium dioxide

The wave lengths of the band heads are now being measured, and it is hoped to give fuller details elsewhere

S F Evans
Physics Department,
Armstrong College (University of Durham),
Newcastle-upon-Tyne

Dissociation Energy of Zn_2 Molecules

It has been shown by me (*Zeits f Phys*, 55, 338, 1929) that the dissociation energy of Hg_2 molecules is greater than has been supposed Also, for Cd_2 molecules several optical data show that we have to deal with high dissociation energy (23 kcal /mol given by Jablonski) The dissociation energy of Zn_2 molecules found by Winans cannot be considered as probable, because Jablonski and Kapuscinski have shown that the considerations of Winans led to erroneous value for the dissociation energy of Cd_2 molecules Therefore it seems interesting to make

direct measurement of the evaporation energy of Zn_2 molecules This last value was found from changes of the band absorption coefficient to be dependent upon the temperature of saturated zinc vapour Preliminary microphotometric measurements of photographic plate density were made for three wave lengths, 2313, 2502 and 2558 A for the range of temperatures 790°–920° C The results of calculations give a number of values which do not differ more than 3 kcal /mol from the average value 32 kcal mol It is thus possible to give in a table a comparison of energies of evaporation of atoms (1), of corresponding molecules (2) and their dissociation energies (3), for three elements—zinc, cadmium, and mercury (in kcal /mol)

	1	2	3
Zinc	30 5	32	29
Cadmium	26 5	30	23
Mercury	14 5	11	18

The value of evaporation energy of Hg_2 molecules was given by me in a former paper (l c), the dissociation energy of Zn_2 and Hg_2 molecules results from the corresponding evaporation energies of atoms and molecules, the value of evaporation energy of Cd_2 molecules were found by putting for the dissociation energy the value given by Jablonski

These results show that the absorption band system of zinc vapour found by Mohler and Moore in the wave length range 2636–2551 A corresponds to the $2^3P\ 1^1S_0$ atom transition For the author found the continuation of this band system in the directions of shorter and longer wave lengths, the limit of convergence of these bands corresponds sufficiently well to the calculated dissociation energy of Zn_2 molecules

S MROZOWSKI

Physical Laboratory of the Society
of Sciences and Letters, Warsaw

Electronic Fine Structure in Helium Bands

EXPERIMENTAL evidence for the triplet nature of the $2\pi^3\Pi_g$ and $2\pi^3\Pi_u$ terms of the helium molecule has recently been given by Prof Mulliken and Dr Monk

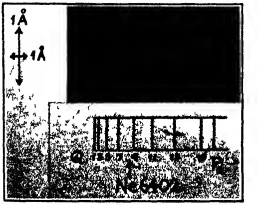

FIG 1.

with their grating spectrograms of the band 6400 A (*Phys Rev*, 34, 1530, 1929) The resolution into doublets (two of the triplet components being too near to be resolved) is more clearly shown on our interference spectrogram of the same band (Fig 1) The photograph was taken by projecting horizontal fringes formed by a 40 plate echelon (resolving power, c 400,000) on to the fairly wide slit of a plane grating spectrograph, the latter giving a dispersion of 3 2 A per mm in the first order The exposure was one hour The neon (impurity) line 6402 246 A served as the standard of measurements, as this line appears in two consecutive orders, their distance $\Delta\lambda_{max}$ being 0 64057 A

The measured doublet separations are

BAND 6400 A

Line	Q_1	Q_3	Q_5	Q_7	Q_9	Q_{11}	Q_{13}	Q_{15}
$\Delta\lambda$ (A)	0 145	0 115	0 119	0 114	0 109	0 111	0 10	0 08
$\Delta\nu$ (cm $^{-1}$)	0 354	0 281	0 290	0 278	0 266	0 271	0·24	0 21

Line	P_2
$\Delta\lambda$ (A)	0 110
$\Delta\nu_b$ (cm $^{-1}$)	0 268

Further investigation on this and other helium bands, using a tube cooled with liquid air, is in progress

SUNAO IMANISHI

The Institute of Physical and
Chemical Research,
Komagome, Tokyo,
Japan, Feb 20

Coloured Glass as a Deterrent to House Flies

SOME years ago Messrs W P Hartley, Ltd , jam manufacturers, Aintree, glazed their storage warehouses with yellow glass The warehouses are connected by corridors which were glazed with ordinary glass They noticed that whereas there were always plenty of flies in the corridors these never went into the warehouses They then glazed the corridors with yellow glass, and found that they got rid of the flies from these also

We have heard of other instances where coloured glasses have been used as a deterrent for flies, and we understand that some abattoirs have been glazed with blue glass

As we were continually being asked for advice on this subject, we decided to carry out some experiments in an endeavour to ascertain whether the house fly was susceptible to coloured light, and if so, which colour was the best deterrent We carried out a series of experiments last summer under advice from Prof R Newstead, and found that, everything else being equal, the house fly prefers white light to coloured light, and that red and yellow are the best deterrents Blue and green are not nearly so effective The loss in illumination with red glass being too great for general use, it appears that yellow is the best

Although it cannot be claimed that the use of yellow glass is an absolute preventive, it is a very effective deterrent, and valuable for use in connexion with the storage of food

We do not suggest the use of yellow glass for any building in which people are continually employed, because it has been found that yellow light is bad for the eyes and general health

We cannot find a record of any work on this subject, and intend to continue our experiments during the coming summer In the meantime we wonder whether any readers of NATURE have noticed this peculiar attitude of the house fly towards coloured light, and can offer any explanation

PILKINGTON BROTHERS LTD

Crown Glass Works,
St Helens, Lancs,
Mar 17

Radio Direction-Finding by Transmission and Reception.*

By Dr R L Smith-Rose

THE application of the rotating closed loop direction finder, both as a navigational instrument and as a useful scientific tool in the study of the propagation of electro magnetic waves, has been developing rapidly during the past few years So long ago as 1901 the performance of a direction finder was being studied in America, but owing to its comparative insensitiveness as a receiver the modern radio direction finder owes its success very largely to the introduction of valve amplifiers, which enabled a moderately large reception range to be obtained The practical development of the instrument, therefore, dates from about 1915

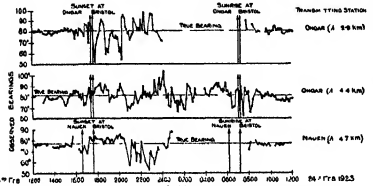

Fig 1 —Graphs of observed bearings of Ongar (undamped waves λ = 2 9 km and 4 4 km) and Nauen (undamped waves, λ = 4 7 km) taken at Bristol over a 24 hour period

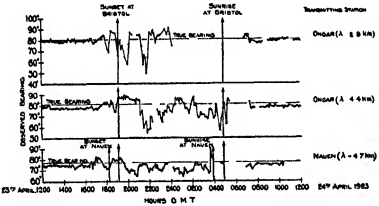

Fig 2 —Graphs of observed bearings of Ongar (undamped waves λ = 2 9 km and 4 4 km) and Nauen (λ = 4 7 km) taken at Bristol over a 24 hour period

The Radio Direction Finder

The several commercial types of direction finder now in use employ the same fundamental principle of the reception of vertically polarised † wireless waves by a closed coil In the attachment of a valve amplifying receiver to the rotating closed coil, the possibility of obtaining spurious electromotive forces in the system is introduced on account of the phenomena generally known as the 'antenna effect' of the coil and the 'direct pick up' of signal electromotive force on various parts of the receiver These spurious electromotive forces make themselves evident by a blurring of the signal zeros, with or without a displacement of these zeros from their correct positions The methods adopted for overcoming these effects are based upon the use of somewhat elaborate screening arrangements, which were employed in the first place in the construction of direction finders for accurate research purposes but are now being applied to commercial instruments In the commercial pattern of rotating loop marine direction finder, the receiving coil is enclosed in a metallic shielding tube mounted on a robust column on the deck above the operating room, in which the rotation of the loop and all receiving adjustments can be effected when it is desired to make bearing observations upon any incoming signals In the case of such use of a direction finder on board ship, the bearing is taken relative to the ship's head, and it is necessary to obtain this direct from the compass reading in order to make the wireless bearing refer to a great circle direction

Before the development of valve amplifiers made possible the use of rotatable multi turn loops, Artom, Bellini, and Tosi suggested and used large frames of a triangular shape for directional wireless communication The large fixed loops employed in this arrangement, now generally known as the Bellini Tosi system, are connected to a radiogoniometer, an instrument which reproduces in miniature the directive properties of the external field of the waves Recent developments of this system for use in ships have resulted in the employment of smaller multi turn loops which are more conveniently fixed on board and are shielded in a manner similar to the single loops referred to above

In the application of a direction-finding system to either marine or aerial navigation, it is important to understand clearly the exact conditions under which the observed bearings are accurate, and in other conditions to appreciate the order of magnitude of the possible errors involved and the means of mitigating these where possible An important factor to be noted from a navigational

* Abstract of a lecture delivered at the Royal Institution on Feb 6

† The term 'vertically polarised' is used here to indicate that the electric force of the wave lies in the vertical plane of propagation

point of view is that of any effect of fog on direction finding, since it is generally during foggy weather that the majority of marine direction finders are called into action The experience of all observers for several years past is in agreement that the existence of fog, whether local or widespread, gives rise to no abnormal effects in direction finding

Various conditions may be present in the neighbourhood of a direction finding station to cause an error in the bearing observed on a distant transmitting station From various detailed investigations into the causes of such errors, it is known that the most prominent effects are due to masses of metal work and wires, either above or below the earth's surface and to trees In most cases where the directional station is situated on land, it is possible to select a site which is largely, if not entirely, immune from such effects In the case of the use of a direction finder on board ship, it is impossible to be clear of the metal work of the ship itself, and the resulting bearings are subject to a quadrantal error which can either be compensated by circuit adjustment or corrected for by a chart

Another type of error which is of some importance in the application of direction finding to marine navigation is that due to the deviation of wireless waves in crossing a coast line when the path of the waves lies approximately parallel to the coast On wave lengths of from 450 metres to 1000 metres, normally used for marine working, the coastal error is of the order of 2°–4° when the direction of transmission is within 20° of the coast line The error is always such as to indicate a bending of the waves towards the normal to the coast line in passing from the sea to the land side of the boundary In connexion with these coastal errors, it is worthy of note that, with the accumulation of experience of the use of direction finders on board ship, it is now becoming customary to mark out on charts the 'arcs of good bearings' of various transmitting stations within which results of observations are found to be trustworthy

As an illustration of the reliability of direction finding as applied to marine navigation, the results of some tests carried out between a direction finding station on the east coast of England and various ships crossing the North Sea may be quoted At the various ranges of transmission up to nearly 120 miles, the limiting error of the direction finder bearing was about 4° In more than 80 per cent of the cases the wireless bearings were correct to within 1°, while the proportion correct to within 2° was nearly 95 per cent These figures refer to bearings taken at a shore station on transmissions from ships across an intervening open sea path at ranges up to about 100 miles Since it is now generally agreed that an accuracy of 2° is adequate for most navigation purposes, it is evident that under its ordinary conditions of use the direction finder is a very trustworthy and useful aid to marine navigation Similar results to the above are obtainable with the direction-finder installation fitted on board ship and observations made on the transmissions from a shore station A large number of fixed beacon transmitting stations are now in operation in various parts of the world for the specific purpose of emitting a regular series of signals for the use of ships fitted with direction finders

NIGHT ERRORS

When the range of transmission is greater than the figure mentioned above the accuracy of the observed direction finder bearings is liable to de-

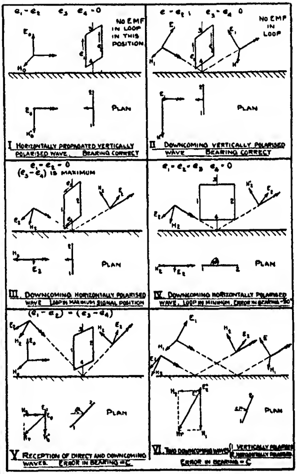

FIG 3

preciate during the hours of darkness, when some erratic variations of the observed bearings take place, accompanied by a change in quality of the signal minima The general nature of these variations can be understood from the typical graphs given in Figs 1 and 2, which show the apparent bearings of some fixed transmitting stations as observed every few minutes over periods of twenty-four hours at one observing station On the wave lengths in question, of 2000–4000 metres, it is to be noticed that the day bearings are much steadier in the summer than in the winter months, but that in either case the approach of sunset is accompanied by an increase in the magnitude and frequency of the variable errors which continues

throughout the night until sunrise Such variable errors may range up to 90° or more, but it is noteworthy that during the night periods the observed bearings show no signs of a definite systematic error, and so the variations are on the whole equally distributed about the true bearing The larger errors are also comparatively rare, in fact, observations over long periods have shown that it is seldom that more than 10 per cent of the night observations give an error exceeding 10°

The cause of the erratic effects and variations observed generally during the night periods is intimately associated with the mode of propagation of electromagnetic waves over the earth's surface This has been the subject of much detailed research during the past few years, and it is now well known that, in general, two sets of waves travel between a transmitting and receiving station—the direct or ground wave, and the indirect or atmospheric wave At short distances from the transmitter, the intensity of the indirect wave is generally small, and only the wave transmitted directly along the earth's surface is of importance in producing the received signal At medium distances, both the direct and the indirect wave are received, while at great distances the major part or the whole of the received signal is due to the indirect wave which has travelled through the upper atmosphere

In order to explain the variations in apparent bearings on the closed type of direction finder we have been considering, it is necessary to assume that the plane of polarisation of the downcoming waves may vary This is undoubtedly caused by a rotation of the plane of polarisation which takes place while the waves are travelling through the ionised regions of the atmosphere and is due to the presence of the earth's magnetic field In Fig 3, diagrammatic illustrations are given of a number of simple cases of the reception of wireless waves on a closed loop, and from these it will be seen that it is the horizontal component of the electric force of the downcoming waves which is responsible for producing an error in bearing So long as the vertically polarised direct wave is strong compared with the horizontally polarised component of the downcoming waves, the error in bearing will be small Thus the variations in bearings close to the transmitter will be small, a conclusion which is confirmed in practice, for night variations are not experienced at distances less than about 30 miles for overland working

(To be continued)

Nobel Prize Awards

FOLLOWING upon the article in our issue of Mar 29, p 495, on the history and constitution of the committees of the Nobel Foundation, we print below a complete list of the recipients since 1901—the date of the first distribution—of Nobel prizes for physics, chemistry, physiology and medicine, classified according to countries, each country representing the working domicile of the recipient at the time of allotment of the prize

Physics

Denmark

1922 Prof Niels Bohr (Copenhagen), for his services in the investigation of the structure of atoms, and of the radiation emanating from them

France

1903 Prof Henri Antoine Becquerel (Paris) In recognition of the special services rendered by him in the discovery of spontaneous radioactivity One half the prize allotted, the other half divided equally between Prof Pierre Curie (Paris) and Madame Curie, for special services rendered by them in the work they carried out jointly in investigating the phenomena of radiation discovered by Henri Becquerel

1908 Prof Gabriel Lippmann (Paris), for his method, based upon the phenomenon of interference, for reproducing colours by photography

1909 Prof Ferdinand Braun (Strasbourg), in recognition of services in the development of wireless telegraphy The prize was divided equally with G Marconi (Italy)

1920 M Charles Edouard Guillaume (Sèvres), in recognition of his services to the physics of precision by his discovery of anomalies in nickel steel alloys

1926 Prof Jean Perrin (Paris), for his works on the discontinuous structure of matter, and especially for his discovery of the equilibrium of sedimentation

1929 M Louis Victor de Broglie (Paris), for his discovery of the wave character of the electrons

Germany

1901 Prof Wilhelm Conrad Rontgen (Munich), in recognition of the exceptional services rendered by him in the discovery of the special rays which have been called after him

1905 Prof Philipp Lenard (Kiel), for his work in connexion with cathode rays

1911 Prof Wilhelm Wien (Wurzburg), for his discoveries regarding the laws governing the radiation of heat

1914 Prof Max von Laue (Frankfort on Main), for his discovery of the defraction of Röntgen rays on passing through crystals

1918 Prof Max Planck (Berlin), for his discoveries in connexion with the quantum theory Awarded in 1919

1919 Prof Johannes Stark (Greifswald), for his discovery of the Doppler effect in canal rays, and of the decomposition of spectrum lines in an electric field

1921 Prof Albert Einstein (Berlin), for his services to the theory of physics, and especially for his discovery of the law of the photo-electric effect

1925 Prof James Franck (Göttingen), and Prof Gustav Hertz (Halle), for their discovery of the laws governing the impact of an electron upon an atom The prize was divided equally in 1926.

GREAT BRITAIN

1904 Lord Rayleigh, for his investigations into the density of the most important gases, and for his discovery of argon in connexion with these investigations

1906 Prof Joseph John Thomson, in recognition of the great services rendered by him in his theoretic and experimental investigations regarding the passage of electricity through gases

1915 Prof William Henry Bragg and Prof William Lawrence Bragg, for their services in the analysis of crystal structure, by means of X rays The prize was divided equally

1917 Prof Charles Glover Barkla, for his discovery of the characteristic Röntgen radiation of the elements Awarded in 1918

1927 Prof Charles Thomson Rees Wilson, for the method discovered by him of perceiving by condensation of steam the paths taken by electrically charged particles The prize for this year was divided equally with Prof A H Compton (United States)

1928 Prof Owen Willans Richardson, for his researches upon the thermionic phenomenon, and especially for his discovery of the law named after him Awarded in 1929

ITALY

1909 Guglielmo Marconi (born Bologna), in recognition of services in the development of wireless telegraphy The prize was divided equally with Prof Ferdinand Braun (Strasbourg)

NETHERLANDS

1902 Prof Hendrik Antoon Lorentz (Leyden), and Prof Pieter Zeeman (Amsterdam), in recognition of the special services rendered by them in their investigations regarding the influence of magnetism upon the phenomena of radiation The prize was divided equally

1910 Johannes Diederik van der Waals (formerly at Amsterdam), for his work in connexion with the equation of state for gases and liquids

1913 Prof Heike Kamerlingh Onnes (Leyden), in recognition of his investigation into the properties of matter at low temperatures which led, amongst other things, to the production of liquid helium

SWEDEN

1912 Gustaf Dalén (Stockholm), for his discovery of automatic regulators, which can be used in conjunction with gas accumulators for lighting lighthouses and light buoys

1924 Prof Karl Manne Georg Siegbahn (Uppsala), for his discoveries and investigations in X ray spectroscopy Awarded in 1925

UNITED STATES

1907 Prof Albert Abraham Michelson (Chicago), for his optical instruments of precision, and the spectroscopic and metrologic investigations which he carried out by means of them

1923 Prof Robert Andrews Millikan (Pasadena, California), for his works on the elementary charge of electricity, and on photoelectric phenomena.

1927 Prof Arthur Holly Compton (Chicago), for his discovery of the phenomenon known by his name The prize for the year was divided equally with Prof C T R Wilson (Great Britain)

The prize for physics for the year 1916 was allocated to the Special Fund for this section

Chemistry

AUSTRIA

1923 Prof Fritz Pregl (Gratz), for the method of micro analysis of organic substances discovered by him

FRANCE

1906 Prof Henri Moissan (Paris), in recognition of the great services rendered by him in his investigation and isolation of the element fluorine, as well as by his introduction to the service of science of the electric furnace called after him

1911 Prof Marie Skledowska Curie (Paris), in recognition of the services rendered by her to the development of chemistry, by her discovery of the elements radium and polonium, by her determination of the nature of radium, and isolation of it in a metallic state, and by her investigations into the compounds of this remarkable element

1912 Prof Victor Grignard (Nancy), for the so called Grignard reagent, discovered by him, which in recent years has greatly advanced the progress of organic chemistry The prize was divided equally with Prof P Sabatier

Prof Paul Sabatier (Toulouse), for his method of hydrogenating organic compounds in the presence of finely disintegrated metals, whereby the progress of organic chemistry has been greatly advanced in recent years

GERMANY

1901 Prof Jacobus Hendrik van 't Hoff (Berlin), in recognition of his special services in connexion with the discovery of the laws of chemical dynamics and osmotic pressure in solutions

1902 Prof Emil Fischer (Berlin), in recognition of his special services in connexion with his synthetic experiments in the sugar and purin groups of substances

1905 Prof Adolf von Baeyer (Munich), in recognition of his services in the development of organic chemistry and chemical industry, through his work on organic dyes and hydro aromatic combinations

1907 Prof Eduard Buchner (Berlin), in recognition of his investigations in biological chemistry and his discovery of cell less fermentation

1909 Prof Wilhelm Ostwald (Leipzig), in recognition of his works on catalysis, as well as for his investigations into the fundamental principles governing chemical equilibrium and rates of reaction

1910 Prof Otto Wallach (Göttingen), in recognition of the services rendered by him to organic chemistry and the chemical industry, through his pioneer work in the field of alicyclic compounds

1915. Prof Richard Willstätter (Munich), for his researches into the colouring matter of plants, especially chlorophyll

1918 Prof Fritz Haber (Berlin-Dahlem), for

the synthetic production of ammonia from its elements Awarded in 1919

1920 Prof Walther Nernst (Berlin), in recognition of his work in thermo chemistry Awarded in 1921

1925 Prof Richard Zsigmondy (Göttingen), for his exposition of the heterogeneous nature of colloid solutions, and for the methods he used in that connexion, which have become a determining factor in the modern chemistry of colloids Awarded in 1926

1927 Prof Heinrich Wieland (Munich), for his investigations into the constitution of the bile acids and kindred substances Awarded in 1928

1928 Prof Adolf Windaus (Göttingen), for his services in the investigation of the constitution of the sterols and their connexion with the vitamins

Great Britain

1904 Sir William Ramsay, in recognition of his services in the discovery of the inert gaseous elements in air, and the determination of their place in the periodic system

1908 Prof Ernest Rutherford, for his investigations into the disintegration of elements, and the chemistry of radioactive substances

1921 Prof Frederick Soddy, for his contributions to the chemical knowledge of radioactive substances, and his investigations into the origin and nature of isotopes Awarded in 1922

1922 Dr Francis William Aston, for his discovery of a great number of isotopes in several non radioactive elements, by means of his mass spectrograph, as well as for his discovery of the whole number rule

1929 Prof Arthur Harden, for investigations on the fermentation of sugars and of fermentative enzymes The prize was divided equally with Prof Hans von Euler Chelpin (Stockholm)

Sweden

1903 Prof Svante August Arrhenius (Stockholm), in recognition of special services rendered by him to the development of chemistry by his electrolytic theory of dissociation

1926 Prof Theodor Svedberg (Uppsala), for his works on disperse systems

1929 Prof Hans von Euler Chelpin (Stockholm), for investigations on the fermentation of sugars and of fermentative enzymes The prize was divided equally with Prof A Harden (Great Britain)

Switzerland

1913 Prof Alfred Werner (Zurich), in recognition of his works on the linking up of atoms within the molecule, whereby new light has been thrown upon older fields of research, and new fields have been opened up, especially within the realm of inorganic chemistry

United States.

1914 Prof Theodore William Richards (Harvard), in recognition of his accurate determination of the atomic weight of a large number of chemical elements Awarded in 1915

The prizes for the years 1916, 1917, 1919, and 1924 were allocated to the Special Fund for this section

Physiology and Medicine

Austria

1914 Robert Barany (Vienna), for his work on the physiology and pathology of the vestibular system The prize was awarded in 1915

1927 Prof Julius Wagner Jauregg (Vienna), for his discovery of the therapeutic value of malaria inoculation in the treatment of dementia paralytica

Belgium

1919 Prof Jules Bordet (Brussels), for his discoveries in connexion with immunity Awarded in 1920

Canada

1923 Prof Frederick Grant Banting (Toronto), and Prof John James Richard MacLeod (Toronto), jointly, for the discovery of insulin

Denmark

1903 Prof Niels Ryberg Finsen (Copenhagen), in recognition of his treatment of disease, especially *lupus vulgaris*, with concentrated light rays

1920 Prof August Krogh (Copenhagen), for his discovery of the regulation of the motor mechanism of capillaries

1926 Prof Johannes Fibiger (Copenhagen), for his discovery of the Spiroptera carcinoma Awarded in 1927

France

1907 Charles Louis Alphonse Laveran (Paris), for his work on the part played by protozoa in the generation of disease

1908 Prof Elie Metchnikoff (Paris), for work (with Prof Ehrlich) on immunity The prize was divided equally with Prof Paul Ehrlich (Frankfort on Main)

1913 Prof Charles Richet (Paris), for his work on anaphylaxy

Germany

1901 Prof Emil Adolf von Behring (Marburg), for his work on serum therapy against diphtheria

1905 Prof Robert Koch (Berlin), for his work on tuberculosis

1908 Prof Paul Ehrlich (Frankfort on Main), for work (with Prof Metchnikoff) on immunity The prize was divided equally with Prof Elie Metchnikoff (Paris)

1910 Prof Albrecht Kossel (Heidelberg), for his achievements in the chemistry of the cell, by his works on proteins, the nucleic substances included

1922 Prof Otto Meyerhof (Kiel), for his discovery of the correlation between the consumption of oxygen and the production of lactic acid in the muscles The prize for the year was divided equally in 1923 with Prof A V Hill (Great Britain)

Great Britain

1902 Sir Ronald Ross, for his work on malaria

1922 Prof Archibald Vivian Hill, for his dis-

covery relating to the heat-production of muscles The prize for the year was divided equally in 1923 with Prof O Meyerhof (Kiel)

1929 Sir Frederick Gowland Hopkins, for the discovery of growth promoting vitamins The prize was divided equally with Dr C Eijkman, Utrecht

ITALY

1906 Prof Camillo Golgi (Pavia), for work (with Prof Ramón y Cajal) on the structure of the nervous system The prize was divided equally with Prof Ramón y Cajal (Madrid)

NETHERLANDS

1924 Prof Willem Einthoven (Leyden), for his discovery of the mechanism of the electrocardiogram

1929 Dr C Eijkman (Utrecht), for the discovery of the anti-neuritic vitamin The prize was divided equally with Sir Frederick Gowland Hopkins (Great Britain)

RUSSIA

1904 Prof Ivan Petrovitch Pavlov (St Petersburg), in recognition of his work on the physiology of digestion

SPAIN

1906 Prof Santiago Ramón y Cajal (Madrid), for work (with Prof Golgi) on the structure of the nervous system The prize was divided equally with Prof Camillo Golgi (Pavia)

SWEDEN

1911 Prof Allvar Gullstrand (Uppsala), for his work on the dioptrics of the eye

SWITZERLAND

1909 Prof Theodor Kocher (Berne), for his work on the physiology, pathology, and surgery of the thyroid gland

TUNISIA

1928 Dr Charles Nicolle (Tunis), for his work on typhus exanthematicus

UNITED STATES

1912 Dr Alexis Carrel (New York), for his work on vascular ligature and on the grafting of blood vessels and organs

The prizes for the years 1915, 1916, 1917, 1918, 1921, and 1925 were allocated to the Special Fund for the section

On Founder's Day, Dec 10, the anniversary of the death of Dr Nobel, the adjudicators hand to the designated prize winners a draft on the Foundation for the amount due, together with a diploma and a medal in gold, bearing the testator's effigy on the obverse, and an emblematic design on the reverse

It is incumbent on a prize winner to give a lecture, if feasible, on the subject of the work for which the prize was awarded, within six months of the Founder's Day at which the prize was won, and to be given at Stockholm

Obituary

EDWARD CLODD

"Thou pirate nested over Alde!
Stern wrecker of the Established Faith!
From whom the parson shrinks appalled

A beacon to thy fellows, Clodd"
GEORGE MEREDITH, 1899

EDWARD CLODD was born at Margate on July 1, 1840 He died at his home, Strafford House, Aldeburgh, on Mar 16 He had been cruelly paralysed and largely deprived of his speech during nearly two years past but was otherwise mentally alert, he was overcome by a sudden attack of asthma, lasting barely a week His body was cremated, at Ipswich, on Mar 20, at the close of a short Rationalist service at which the few who remain of his old friends were mostly present His ashes are now cast into Aldeburgh Bay He seems to have passed away in full consciousness, satisfied to have made good use of his earthly heritage, free from all selfish wish on his own account—only sorry to go because he found the world so intensely interesting His great friend Hardy held this view at the end To have been with such men is to know the peace that knowledge can give

He came from the sea and the soil, the name being one of long standing in Suffolk At the time of his birth, his father was captain of a brig He was nurtured at the brink of the sea, at Aldeburgh, of which small town his parents were natives On joining his yacht, the *Lotus*, you naturally reported yourself—'Come aboard, Sir", he was so thoroughly the stocky, sturdy sailor in figure, with all the sailor's winsome ways Behind the sailor was a man of an astounding literary culture, burning with curiosity, ever seeking really to know, at heart he was both the man of letters and the scientific inquirer, a rare combination—though without technical training He was self educated in this respect and with wonderful finish His mother taught him to read, the Bible especially, to the end, he advocated its use, not in the service of dogmatic teaching but as the greatest work of literature in our language

Clodd was simply but well trained up to fifteen years of age, at the Aldeburgh Grammar School The head, Mr Buck, definitely imbued him with the love of learning, at his suggestion, in later years (1861), he was to write a guide to Aldeburgh In 1865 he produced a life of Crabbe, the Aldeburgh poet, the literary afflatus was in him from an early age He was meant for the Church but his imagination was so stirred, in 1851, by a visit to the Great Exhibition, that in 1855, like Whittington, he took his future into his own hands and went to London town, where he had an aunt and an uncle After serving in various offices, in 1862 he became a clerk in the London Joint Stock Bank, he then married Ten years later he was appointed secretary, a position he held until June 1915 Although not

built of business stuff, he was exactly fitted for this office It brought him into contact with many interesting men One instance he gave me—when Hughes, who later invented the microphone, came over from America, he called at the bank and saw Clodd, on leaving he deposited £7000 he had saved mostly from his earnings as a teacher of music This was at the time when gas was at its lowest owing to the introduction of the electric light and it was by happy investment in gas stock that Hughes was able to amass his fortune When he died he appointed Clodd his trustee Clodd was also trustee to 'Amazon' Bates and to Holman Hunt

He had two great gifts—the one to which he owed his literary success was the rare one of reading exactly Taking down any book in his library, you saw at once that it had been read word for word Passage after passage would be underlined and a multitude of cross references written in the margin Press notices and letters from the authors were to be found in most He had an astounding memory and to the last remembered what he read He was a critical master of anthropological literature

In his first London days he not only read hard but also attended sermons and lectures It was the time when scientific criticism began to stir the intellectual world and he was soon caught in the stream He early began to wear the shoes of Nonconformity loosely, they were unlatched when he wrote his "Childhood of the World" (1872) and came off altogether in writing his really daring "Jesus of Nazareth" (1880) From that time onwards, he was a declared anti clerical He was a Rationalist through intense logical study of the evidence He was stirred to write the "Childhood" by asking himself in all sincerity how and what he could safely and honestly teach his young children he soon felt obliged to depart from current practice "Jesus of Nazareth" appeared as a gift from the gods to a man like Huxley, to Ruskin it was anathema The original 'author's copy' on his shelves has in it a most remarkable set of letters received from all and sundry, including advanced clerics, giving their opinions upon the work Although he had no use for man made gods, no use for metaphysics, at heart he was deeply religious

Clodd's second gift, that which made him so loved, was his abounding genius for friendship His books soon brought him recognition but he had only to make one friend to be offered another and he never hesitated to offer himself freely, even to strangers, if he wished to know them His Aldeburgh home became a magnetic centre to men of distinction in every walk, excepting politics and the church

His "Memories" (1916) gives some picture of the variety of Clodd's friendships Hardy and Meredith were among them, he had author's copies of many of their works Not a little of the delight of his week ends was derived from excursions on the Alde in *Lotus* I and II—a small sturdy vessel built much upon his own lines, which sailed almost as close to the wind as he did to dogmatists and doctrine-mongers I was out with him on his last cruise, two years ago I shall never forget two occasions when his great friend Sir Mortimer Durand was our only companion Of course we discussed far Cashmere and Persia On one of these, a violent thunderstorm, which forced us to down all sail until the clouds rolled by, brought us close to the inner meaning of things as we now are by the life of a man like Edward Clodd, verily of the salt of the earth He seemed to have no original genius, yet an innate gift of using knowledge to the full Is it not time that we followed the great example of scientific service that he has set and made our knowledge of more avail? Relatively, to-day, there is great over production of knowledge, great under production of users of knowledge on the public behalf

Henry E Armstrong

Clodd was one of those numerous business men in whom Great Britain may justly pride itself, who devote their leisure to scientific and literary pursuits During forty three years he was secretary of the London Joint Stock Bank, but found time to read widely in science and literature, and being endowed with a notable gift of friendship, he became the friend of such diverse people, to name only a few, as T H Huxley, Sir William Huggins, R A Proctor, H W Bates, Joseph Thomson, Paul du Chaillu, Edward Whymper, Sir Alfred Lyall, J Cotter Morison, F York Powell, George Meredith, W Holman Hunt, Andrew Lang, Samuel Butler, Thomas Hardy

When "The Origin of Species" was published, Clodd was an ardent and inquiring young man of twenty, and the discussions which arose interested him keenly, the publication of "Essays and Reviews", followed ten years later by "Primitive Culture", together with wider reading, finally emancipated him from the strict orthodoxy in which he had been brought up Owing to the absence of a book suitable for the young on the story of man's progress, Clodd wrote "The Childhood of the World a Simple Account of Man's Origin and Early History" (1873) which has gone through numerous editions and been translated into many European languages and even into Becowana and Secwana It is impossible to estimate what effect this lucid and charming presentation of 'the new learning' had in Europe and America The polemics of the mighty were thus made easily understandable, and the young were made aware of the trend of modern thought in a manner that must have influenced their outlook on life

Two years later "The Childhood of Religion" inevitably followed, and also had a great sale Here Clodd was treading on more debatable ground, but the spirit in which it was written is admirable, though it doubtless alarmed some readers "The Story of Creation a Plain Account of Evolution" appeared in 1888 and rapidly went through many editions, and it also must have considerably, if unconsciously, affected the rising generation In 1895 followed "A Primer of Evolution" and "The Story of Primitive Man". "Pioneers of Evolution

from Thales to Huxley", in 1897, was the last of his popular expositions of evolution

Clodd was from its early days an active member of the Folk Lore Society, of which he was president in 1895 and 1896 Besides his two presidential addresses, he made various contributions to the Society's journal In 1885 he published "Myths and Dreams", and in 1898, "Tom Tit Tot, an Essay on Savage Philosophy in Folk lore", which is a delightful example of one aspect of the study of folk lore A compact little book, "Animism the Seed of Religion", appeared in 1905, and "Magic in Names and in other Things" in 1920, this is the most elaborate of Clodd's writings on folk belief and is as vividly written as his other books

In 1892, Clodd published a memoir of H W Bates in "The Naturalist on the River Amazons", in 1900 one on "Grant Allen", and in 1902 another on "Thomas Henry Huxley" In 1916 he de lighted his numerous friends with the publication of "Memories", and those who desire to know what Clodd was to his friends should read this book and incidentally they will discover what manner of man he himself was

The above list of some of his books, and his very numerous contributions to journals of all kinds, indicate that Clodd was a sower of the seed of intellectual freedom and a populariser of evolution, more particularly as regards man This is not the place to refer to his many literary associations, but no mention of Clodd would be complete without allusion to the stimulating quality of his conversation and to the notable gatherings at his home, where men of varied experience, activities, and research interchanged serious talk enlivened by jest Clodd was a perfect host, and not least so when as skipper he took his party for cruises in the *Lotus* We have lost a great friend, and we offer our heartfelt sympathy to his devoted wife, who made his declining years so happy

A C HADDON

WE regret to announce the following deaths

Prof J O Arnold, emeritus professor and lately dean of the Faculty of Metallurgy in the University of Sheffield, on Mar 24 aged seventy two years

Dr Wilhelm Biedermann, formerly professor of physiology in the University of Jena, on Nov 27, aged seventy five years

Sir Edward Brabrook, C B, a past president of the Royal Anthropological Institute and of Section H (Anthropology) and also of Section F (Economic Science and Statistics) of the British Association, on Mar 20 aged ninety years

Dr Hermann von Ihering, honorary professor of palæontology at Göttingen, for many years director of the Museu Paulista at São Paulo, Brazil, who was well known for his studies in zoo geography, the palæontology and fauna of Brazil, and the morphology and classification of the Mollusca, on Feb 24, aged seventy nine years

Sir William M'Cormick, G B E, F R S, chairman of the University Grants Committee and of the Advisory Council on Scientific and Industrial Research, on Mar 22, aged seventy years

Prof Wilfred Robinson, professor of botany at the University College of Wales, Aberystwyth, on Mar 7

News and Views

CONGRATULATIONS from a wide circle of friends will be extended to Prof George Forbes, one of our veteran electrical engineers, who celebrates his eighty first birthday on April 5, having been born in 1849 He is the son of Principal David James Forbes, and graduating in the first instance at the University of St Andrews, he went on later to Cambridge Respecting his youthful adventures, our readers will doubtless recall a recent article in the *Times* by him recounting work as a war correspondent, and impressions, whilst in the service of Delane, the editor of that journal Forsaking journalism, Forbes embraced a scientific career, becoming in the first instance professor of natural philosophy at Anderson's College, Glasgow, afterwards devoting himself to notable electrical projects He was electrical engineer for the initial series of installations at Niagara Falls, 1891-95, besides being associated with numerous other undertakings which attest the foresight and skill of the electrical engineers of a pioneer period In 1887, Prof Forbes was elected into the fellowship of the Royal Society. He is a Chevalier of the Legion of Honour of France and honorary LL D of St Andrews

CELEBRATIONS in connexion with the eightieth birthday of Dr William Henry Welch will take place in Washington, U S A, on April 8 A broadcast of the ceremonies will be relayed from the London Regional Station at 5 P M. Dr Welch's name is a household word to doctors all over the world In 1884, when the bequest of a rich American, Johns Hopkins, led to the foundation of a new university in Baltimore, Dr Welch was chosen first professor of pathology A few years later he was joined by the late Sir William Osler as professor of medicine Mainly through the genius and enthusiasm of Welch, Osler, and the late Prof Halsted—the famous surgeon—the new school rapidly rose to the first rank, and for more than a generation Johns Hopkins has been the goal of advanced students and research workers from all parts of the world Dr Welch, who has since been Director of the School of Hygiene of the Johns Hopkins University, and is at present professor of medical history there, has lived to see the educational ideals for which he fought universally adopted, and to be admitted into the class of the great masters of medicine, the class of Lister, Koch, Pasteur, and Manson In connexion with these ceremonies in America, an address, with lantern illustrations, will be given at the London School of Hygiene and Tropical Medicine, at Keppel Street (Gower Street), W C, by the director, Sir Andrew Balfour, on Dr Welch's life and work, on the same day at 4 P M

As has already been announced, the Council of the Physical Society has awarded the Duddell Medal for 1929 to Prof A A Michelson, of the University of Chicago, and at the annual general meeting on Mar 28

the medal was handed to Mr David Mc K Key, Third Secretary of the Embassy of the United States of America, on behalf of Prof Michelson The interferometers invented by Prof Michelson, of which the first was used for carrying out in 1887 the famous Michelson and Morley experiment, have been applied by him, always with complete adequacy of design, to other important and difficult problems, most of them of audacious novelty These problems included the measurement in 1892 and 1893 of the metre in wave lengths of light, the measurement of the diameters of stars, the re measurement of the earth tides, and the testing of the effect of the earth's rotation on the velocity of light These measurements have had far reaching consequences for physical science

The difficulties of reconciling the result of the Michelson Morley experiment with the then prevailing physical conception of the nature of the universe were the direct cause of the inquiry of Albert Einstein, which resulted in the theory of relativity The measurement of the metre in wave lengths of light resulted in establishing a standard of length free from the uncertainty concerning possible variation which attaches to all material standards The interferometer for the measurement of the diameter of stars, suggested by Michelson in 1890 and first applied by him to Betelgeuse, has not only confirmed the correctness of the almost incredible dimensions yielded by indirect means of calculation, but also has detected fresh stellar phenomena in the variable diameter of Mira Ceti, and the separation of double stars too close for resolution by the unassisted telescope The invention by Prof Michelson of the echelon diffraction grating provided physicists with a potent tool for the investigation of the fine structure of spectral lines, knowledge concerning which has become of such great importance in modern physics Prof Michelson has also designed a ruling engine with which very large gratings have been ruled As a final example of his work on scientific instruments for the advancement of knowledge, mention may be made of the completion by him in 1926, with apparatus designed by himself, of a redetermination of the velocity of light The elaborate precautions taken to secure freedom from error included means whereby the distance of eighty two miles traversed by the light was measured to a higher degree of accuracy than had ever been reached in triangulation

Two honours highly prized by chemists were conferred at the annual general meeting of the Chemical Society on Mar 27 Presenting the Longstaff Medal to Dr W H Mills, the president, Prof J F Thorpe, said that this gold medal is awarded triennially to the fellow of the Society who, in the opinion of the Council, has done the most to promote chemical science by research He mentioned Dr Mills's investigations of the cyanine dyes and their uses as photographic sensitisers, and referred to his researches on the occurrence of optically active forms of those substances which possess molecular dissymmetry, such as the ketodilactone of benzophenone 2 4 2′ 4′ tetracarboxylic acid and the pyridylhydrazone of *cyclo*hexylene dithiocarbonate Dr Mills has thereby established the fact that the cause of the absence of optical activity among aromatic derivatives due to the uniplanar character of the benzenoid structure is no longer effective when two rings are joined in such a manner as to make them lie in different planes, and he has emphasised this conclusion by resolving benzene sulphonyl 8 nitro 1 naphthylglycine, thus showing that the inhibition of free rotation about a single bond leads to molecular dissymmetry The Harrison Memorial Plaque and Prize was awarded to Dr R P Linstead for meritorious original contributions to chemical science Prof Thorpe said that it is seldom that a research worker within the age limits demanded by the trust deed strikes out a line for himself and does not merely elaborate and extend the research problems on which he has been trained Dr Linstead has devised and established on a sure basis a means by which it is now possible to determine the relative proportions of the constituents present in equilibrium mixtures formed by the interchange of the $\alpha\beta$ and $\beta\gamma$ structures of substances exhibiting three carbon tautomerism, whereby the close and quantitative study of this fundamental phenomenon can be effected

The discussion on beam radio telephony in the House of Commons on Mar 27 was naturally more political than scientific Points were scored by the various speakers, but we do not think that these much affect the main issue We referred to the subject in a note in our issue of Mar 8, p 386 World intercommunication cannot be considered with regard to the interests of one centre alone When H W Nicholls read a paper on trans oceanic radio telephony to the Institution of Electrical Engineers in London on Feb 22, 1923, he described some of the results obtained by the American Telephone and Telegraph Company and the Radio Corporation, which now allow us to engineer the Atlantic radio link In particular, he described a method of suppressing one of the side bands, a discussion on the existence of which has recently taken place in our pages When we first heard perfect speech being reproduced across the Atlantic, we recognised what a debt we owed to the Americans Now Sir E Hilton Young says that if the Post Office does not co operate with Imperial and International Communications, Ltd, it must co operate with some one else In particular, he stated that it is co operating with the great American cable companies and not with British interests We think that he takes too narrow a view The Post Office is not jealous of the Imperial and International Communications, Ltd, and on many occasions it has proved that it is not autocratic It is true that the Standard Company has some American capital, but there are many other large engineering firms in Great Britain which have also American support It is a British factory employing British workers and doing a large amount of work for foreigners We see no reason why the Post Office should not establish communication with Buenos Aires through foreign capitals if it is commercially convenient The development of radio communication has been so rapid of recent years that it is inadvisable to hamper the Post Office in any way

Dr John Radcliffe, the outspoken physician who told Queen Anne that she was only suffering from the "vapours", and William III that "he wouldn't have William's two legs for his three Kingdoms", was a liberal benefactor to his own College and to the University of Oxford About sixty years after his death, the trustees under his will built the Observatory which bears his name This was done at the request of the University, and there is no doubt that the trustees from the beginning always considered that they were under special obligations to the University and City of Oxford The Observatory having lately come into the possession of £100,000 by the sale of its site, the trustees have before them a proposal to move the Observatory and its belongings to South Africa, on the ground that so large a sum could not be usefully spent on astronomy in Oxford The trust is not a department of the University but, as has been pointed out by Lord Birkenhead as High Steward, it is at least doubtful whether the trustees are so far independent as to be legally entitled to alienate from the University property with which it has been intimately connected for many years It may be noted that both the Board of Faculty of Natural Science and the Hebdomadal Council have expressed disapproval of the plan now before the trustees

Prof G von Hevesy, who delivered the Hugo Muller lecture before the Chemical Society on Mar 26, chose as his subject the chemistry and geochemistry of the titanium group of elements Speaking in English, without the aid of a manuscript, Prof von Hevesy first discussed the distribution and geochemical relationships of this group of elements, of one of which, hafnium, he is the discoverer When the earth cooled, members of the titanium group became concentrated in the earth's crust, the average titanium content of the material of the whole earth is about 1 in 600 From considerations of loss of heat by the earth, thorium has been considered to be strongly concentrated in the earth's crust, and it is significant that geochemical considerations lead to the same result Of this group, only titanium, zirconium, and thorium are found as the major constituents of minerals Discussing the comparison of the chemical properties of the elements, Prof von Hevesy mentioned that, failing an accurate comparison of ionisation potentials, the relative ionic sizes are of value There is little or no difference in molecular volume between the dioxides of zirconium and hafnium, whilst the atomic volume of hafnium is in fact slightly less than that of zirconium, the ionic radii of the two elements are equal Separation of zirconium and hafnium is rendered difficult by the very small differences in the solubilities of corresponding compounds, although advantage may be taken of such differences in double fluorides, and of the differing solubilities of the phosphates or oxychlorides in hydrochloric acid Prof von Hevesy next discussed the position of hafnium in the periodic classification of the elements with reference to its basicity, and then referred to the analytical chemistry of the group Success has attended the application of methods employing radioactive indicators to minerals containing very small quantities of hafnium, and X ray spectroscopy has also proved a valuable analytical instrument

For his Friday evening discourse delivered at the Royal Institution on Mar 28, Sir Ernest Rutherford took as his subject "The Transmutation of Matter" The idea that one metal could be transmuted into another first arose among the Greeks in Alexandria in the first few centuries A D, and spread through Europe in the Middle Ages With the discovery of the periodic relationship in the properties of the elements the belief in transmutation revived, and Faraday remarked, 'To decompose the metals, to reform them and to realise the once absurd notion of transmutation—these are the problems given to the chemist for solution" In 1919, Rutherford showed that some of the nuclei of the atoms of nitrogen could be transformed by bombardment with the swift α particles emitted by radium Afterwards, Rutherford and Chadwick found that a number of the lighter elements showed a similar effect and in all cases a swift proton was found to be emitted in consequence of a violent collision between an α particle and the atomic nucleus Our evidence indicates that in the case of nitrogen, the α particle is captured during this process and the mass of the resulting atom is greater than before In general, only about one α particle in 100,000 comes close enough to a nucleus to effect its disruption Transformation of an atom would occur also if an electron could be forced into a nucleus In recent years numerous experiments have been made to change mercury into gold and lead into mercury by means of intense electrical discharges, but there is no certain evidence that any transmutation occurs by this method Apart from the radioactive bodies, it now seems clear that a large amount of energy must be applied to produce a disruption of the nuclei of the ordinary elements The old idea that a new source of energy could be tapped by transformation of the ordinary elements now seems untenable There remains, however, one interesting possibility If hydrogen nuclei—protons could be made to combine to form a nucleus of helium, an enormous amount of energy should be emitted during this process Unfortunately, there is as yet no evidence that such a combination could be produced under conditions available in our laboratories

In the past few years there has been an unprecedented activity in the development of apparatus for all aspects of kinematography, and the number of applications for patents has been particularly large There has been much discussion as to the validity of many of these apparently new inventions These facts give an interest, over and above the purely historical, to the Will Day historical collection of kinematography and moving picture equipment, which is about to be offered for sale This collection is unique and exceptionally comprehensive There is no important stage in the development of moving pictures, with the exception of sound kinematography, which is not represented in Mr Day's collection The majority of the items are well known to the public, as they have been on exhibition at the Science Museum, South

Kensington, for a number of years At the Museum they have been so adequately displayed and tended that it is to be regretted that it appears probable that the Museum will be deprived of every item of the collection after the sale It is, perhaps, unfortunate, that the collection is to be sold as a whole We should naturally like to know that the objects representing the pioneer work of W Friese Green, R W Paul, Birt Acres, and other Englishmen had a chance of remaining in England France would doubtless welcome an opportunity to acquire the apparatus of the brothers Lumière, without having to purchase the entire collection

The Will Day collection comprises some five hundred items, including not only apparatus for recording and reproducing apparent motion, but many unique specimens of early films, and a collection of books, papers, prints, playbills, and early documents relating to the subject of moving pictures and their public presentation The illustrated catalogue of the collection, sold at five shillings by the auctioneers, Messrs Harris and Gillow, 80 82 Wardour Street, W 1, is one of the most valuable contributions to the history of kinematography yet published A detailed description of each of the separate items is preceded by a foreword on the historical development of moving pictures by Mr Will Day Tenders for the collection in its entirety have to be made to the auctioneers before noon on May 3 It is difficult to see how it will be possible to assess the value of such a collection Is it too much to hope that it will fall into the hands of a public spirited purchaser, who will see to it that each country eventually has the opportunity of acquiring that portion in which it has a national interest ?

The introduction of foreign species of animals to any country is always a matter of difficulty and generally of controversy, owing to the clashing of interests which take very different points of view The sportsman and the animal exploiter seldom see eye to eye with the purist who would reserve a country for the country's own produce The position of the sportsman is easily appreciated He is in sympathy with the preservation of the native fauna—he has indeed done much to keep it in being—but if the supply of game is to be maintained or increased where sport becomes more popular and more democratic, then he must turn to foreign birds Then he must choose amongst the species which will thrive in his own country, and from these must select those which, while affording good sport, respond most profitably to the known methods of game propagation The position is particularly interesting at the moment in the United States of America The love of sport, or at any rate the desire to shoot something within the law, is increasing there enormously, and with it the demand that there should be plenty of sporting gun fodder Where native birds are big enough and abundant enough, the only danger is that they may not be able to last out the succession of annual pushes, but where native species are not sufficient, then recourse must be made to introductions of foreign blood

The situation in the United States is put quite clearly by W L. McAtee, the biologist in charge of food habits research in the Biological Survey of the U S Department of Agriculture "Let the native game birds enjoy the protection of game sanctuaries as numerous and extensive as can be afforded, but on those parts of our domain where public shooting is practical and its continuance is desired, the practical necessities of the situation require the use of species of game birds that will produce the best results, regardless of their origin" As a consequence an inquiry has been made as to the "Game Birds suitable for naturalising in the United States," and a pamphlet under that title has been issued by the U S Department of Agriculture (Circular No 96) The dangers of introducing possible pests or foreign bird diseases, or of depleting the food supply of native birds, have been foreseen, and in selecting suitable areas for introductions consideration has been given to latitude, temperature, and precipitation compared with those of the original habitat The bulk of the species regarded as the most promising importations are various kinds of pheasants and partridges, but guinea fowls Mexican quails, bustards, and sand grouse are also recommended The natural vegetation of the United States is regarded as unfavourable to the sustenance of red grouse or black grouse, and capercailhe, snow cock, and wood pigeons are looked upon as undesirable, in the last case on account of the damage they are likely to do and in the former because of the unpalatable quality of their flesh

By the courtesy of the Trustees of the British Museum, the British Association is enabled to supplement its recent researches on ancient sites in Southern Rhodesia by a loan exhibition of all the more important antiquities from Zimbabwe and elsewhere, which were scattered among the museums of South Africa Especial thanks are due to the South African Museum at Cape Town, the Rhodesian Museum at Bulawayo, and the Queen Victoria Memorial at Salisbury, for allowing their treasures to travel so far, and also to the Government of Southern Rhodesia for permitting the exhibition of the finds from Miss Gertrude Caton Thompson's excavations last year at Zimbabwe, and Mr A L Armstrong's exploration of the Bambata Cave in the Matoppo Hills It is believed that other objects from earlier explorations at Zimbabwe are in private collections in Great Britain, and it is hoped that if their possessors are willing to allow any of these to be exhibited, they will send them without delay addressed to the Zimbabwe Loan Exhibition, care of the Director of the British Museum, W C 1 The Exhibition, which enjoys the patronage of Their Excellencies the Governor General of the Union of South Africa and the Governor of Southern Rhodesia, will be opened free to the public on Monday, April 7, in the Assyrian Basement of the British Museum, and will remain open until the middle of May

According to a message from the Riga (Latvia) correspondent of the *Morning Post*, published on Mar 24, a communist of the name Volgin has been

appointed as the new permanent secretary of the Academy of Sciences of Leningrad, after the dismissal of the former permanent secretary, Prof S Oldenburg (see NATURE, Nov 16, 1929, p 767) In an interview with representatives of the Press, the newly appointed secretary stated that a new statute of the Academy has been drafted which requires all the academicians not only to show scientific attainments, but also to pay strict obedience to political orders and to help in the Socialistic reconstruction of U S S R It appears likely that should the present policy be continued, all the older members of the Academy will soon be displaced by others, whose achievements in adhering strictly to the Soviet Government's political principles are likely to be greater than their attainments in science The recent dismissal of A A Birula from the post of Director of the Zoological Museum of the Academy is a further demonstration of the Soviet Government's attitude towards the older scientific workers in Russia During the same interview, M Volgin stated that even foreign honorary members of the Academy will be required to show themselves friendly to the revolutionary movement of the proletariat

IN the presence of members of the Council of the Research Association of British Paint, Colour and Varnish Manufacturers, Mr S K Thornley, the president, on Mar 21, laid the foundation stone of a large extension of the premises of the Research Station at Waldegrave Road, Teddington Before laying the stone, Mr Thornley said that already we have had sufficient experience of the working of the research association idea on the utilisation of existing knowledge and the discovery of new knowledge to know that it is well worth while It damages no one and is to the advantage of all Co operative research is a valuable if not the only convenient means for most people to participate in the inevitable scientific advance The foundation stone bears the inscription "Scientia socia industriae" (science the ally of industry) This stone was laid by Samuel Kerr Thornley, President, Research Association of British Paint, Colour, and Varnish Manufacturers, 21st March 1930

DR L COCKAYNE, who was awarded the Darwin Medal for 1928 by the Royal Society for his contributions to ecological botany, has been appointed honorary botanist to the Wellington City Council, New Zealand

A CONSIDERABLE earthquake was recorded at Kew Observatory on Mar 26 The first impulse reached the Observatory at 7 hr 32 min, 12 sec The records indicate that the epicentre was situated in the south west of China

AT the annual general meeting of the Television Society the following were elected officers for the current year *President*, Sir Ambrose Fleming, *Hon Treasurer*, Mr W C Keay, *Hon Secretaries*, Mr J J Denton and Mr W G W Mitchell Mr J L Baird was elected an honorary fellow of the Society

DR A T DOODSON, associate director of the Liverpool Observatory and Tidal Institute, has been awarded a prize of £150 offered by the Royal Society of Arts in 1929, under the Thomas Gray Memorial Trust, for an improvement in the science or practice of navigation, for his work on the analysis and prediction of tidal currents

AT the annual election of office bearers of the Royal Philosophical Society of Glasgow, to fill vacancies, the following were elected *Vice President*, Mr David Begg, *Members of Council*, Mr G D Buchanan, Dr G H Edington, Mr W Gillies, Prof G W O Howe, *Hon Secretary*, Prof C R Gibson, *Hon Treasurer*, Sir John Mann, *Hon Librarian*, Dr J Knight, *Hon Auditors*, Mr J T Tulloch, Mr J J D Hourston, *Acting Secretary*, Dr J M Macaulay

IT would appear that in our review of "The World's Grasses" by Prof J W Bews in our issue of Jan 25, p 119, we failed to view the entire field We are now informed by Mr A S Hitchcock, of the U S Department of Agriculture, that *Bromus secalinus* is cultivated in the valley of the Columbia River *Bromus arvensis* is also cultivated as a crop in some European countries, so that this fact should have been referred to as an addition to, rather than as a correction of, Prof Bews's statement

AT the annual meeting of the Ray Society, held on Mar 21, Prof W C M'Intosh was re elected president, Sir Sidney F Harmer treasurer, and Dr W T Calman, secretary Sir David Prain was elected a vice president and Canon Bullock Webster and Mr C H Oakden new members of the Council The Council's report announced that the issue for 1930 would consist of a volume on "The Aquatic (Naiad) stages of British Dragonflies", by Mr W J Lucas, it will be illustrated with coloured plates which are now in course of reproduction from the author's own drawings A work on "British Freshwater Copepoda", by Dr R Gurney, has been accepted for publication and its preparation is well advanced

A GENERAL discussion on "Optical Rotatory Power" will be held by the Faraday Society on Friday and Saturday, April 25 and 26, in the rooms of the Chemical Society, Burlington House, Piccadilly, London The meeting will open with an introductory paper by Prof T M Lowry, and the proceedings will be in four groups dealing respectively with (1) The physical basis of optical rotatory power, (2) apparatus and methods, (3) rotatory power of solutions, and (4) chemical aspects of optical rotatory power The programme is noteworthy for the number of foreign scientific workers who have furnished papers Members of allied societies, research students, and others interested, whether members of the Faraday Society or not, are invited to be present at the meeting

Two Chadwick Public Lectures, delivered by Mr Arthur J Martin, on "Sewage and Sewage Disposal", have been published (Macdonald and Evans, 8 John Street, W C 1 Price 2s 6d net) The booklet gives an interesting and instructive survey of the advances that have been made in recent years in the treatment of sewage, and concludes with a description of the activated sludge process, various modifications of which are now regarded as being the best means for the treatment of sewage

THE latest catalogue (No 523) of Francis Edwards, Ltd, 83 High Street, Marylebone, deals with second-hand works, 371 in number, relating to West Africa

MR J H KNOWLES, 92 Solon Road, S W 2, has just circulated a catalogue (No 11) of upwards of five hundred second hand books on botany, herbals, phanerogams, floras and cryptogams, zoology and geology

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A principal of the Castleford, Normanton, and District Mining and Technical Institute, Whitwood—M G Swaine, Education Offices, Castleford, Yorks (April 7) A head of the Department of Commerce of the Leicester College of Technology—The Registrar, College of Technology, Leicester (April 7) A junior assistant in the Wood Chemistry section of the Forest Products Research Laboratory, Princes Risborough, Bucks—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S W 1 (April 8) A designing draughtsman in the Naval Ordnance Department of the Admiralty—The Secretary of the Admiralty (C E Branch), Whitehall, S W 1 (April 12) A lecturer in pharmacy at the Witwatersrand Technical Institute—Chalmers and Guthrie, Ltd, 9 Idol Lane, E C 3 (April 12) A permanent assistant to the adviser in agricultural economics in the Department of Agriculture and Horticulture of the University of Bristol—The Secretary, University, Bristol (April 12) A public analyst for the Metropolitan Borough of Camberwell—The Town Clerk, Town Hall, Camberwell, S E 5 (April 14) A pathologist at the Preston and County of Lancaster Royal Infirmary —The Superintendent and Secretary, Royal Infirmary, Preston (April 17) A research worker at the National Institute for Research in Dairying, for the investigation of problems concerning accessory food factors—The Secretary, National Institute for Research in Dairying, Shinfield, near Reading (April 19) Civilian education officers in the Royal Air Force Educational Service—The Secretary, Air Ministry, Gwydyr House, Whitehall, S W 1 (April 22) A professorship of education in the University College of Hull—The Secretary, University College, Hull (April 23) A lecturer in historical geography at King's College, London—The Secretary, King's College, Strand, W C 2 (April 25) A professor of bacteriology at University College Hospital Medical School—The Academic Registrar, University of London, South Kensington, S W 7 (May 15) Probationers in the Indian Forest Service—The Secretary, Services and General Department, India Office, S W 1 (July 1) A sanitary inspector in the Sudan Medical Service—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S W 1 A physics lecturer at the Newfoundland Memorial College—S T Harrington, Woodfield, Malvern Wells A lecturer in mathematics and physics in the Dudley Training College for Teachers—The Secretary to the Dudley College Council, Education Offices, Dudley A full time teacher of building and civil engineering in the Barnsley Mining and Technical College—The Principal, Harvey Institute, Barnsley

Our Astronomical Column

The New Comet Wilk 1930 *c*.—Mr J P Moller has computed the following orbit of this comet

T 1930 March 28 794 U T

$$\left.\begin{array}{ll}\omega & 46^\circ\ 47' \\ \Omega & 90\ \ \ 4 \\ i & 67\ \ 40\end{array}\right\}\ 1930\ 0$$

log q 9 6841

EPHEMERIS FOR 0^h

	R A			N Decl	
April 2	1^h	0^m	24^s	32°	31′
6	0	43	16	36	37
10	0	24	8	39	32
14	0	3	52	41	41
18	23	43	0	43	14

The comet is visible both in the evening and the morning, but the morning is rather more favourable It attained the fourth magnitude at the end of March, and was visible in twilight The orbit bears some resemblance to that of De Vico's comet, 1846 iv, which has been sought for ten years, but the differences are greater than perturbations are likely to have caused It should, however, be observed as long as possible, to test for any deviation from parabolic motion

Distribution of Matter in Interstellar Space.—Dr J. S Plaskett and Mr J A. Pearce contribute an important paper on this subject to *Mon Not Roy Ast Soc* for January Some months ago Dr O Struve suggested that the intensity of the *H* and *K* lines of calcium in the spectra of early-type stars might be used as a measure of the distance of these stars, since the lines had been shown to arise from matter external to the stars The chief uncertainty was as to whether it was safe to assume that the density of the interstellar gas was uniform throughout space The present paper gives a definite affirmative answer to this question The spectrograms of 261 stars taken at the Victoria Observatory were examined, and the radial velocities both of the stars themselves and of the interstellar gas were analysed by the formulæ derived by Dr Oort for radial motion arising from galactic rotation It is found that the interstellar lines indicate a rotational term of 7 9 km/sec, indicating a mean distance of 465 parsecs, and give galactic longitude 332° (referred to the intersection of the galaxy with the equator of 1900), a value agreeing closely with that found in other ways The distances of the stars, found in a similar manner, are in the mean twice those of the gas, thus giving strong confirmation of the uniformity with which the interstellar matter is distributed, and showing that it shares in the galactic rotation

The Trans-Neptunian Planet.—The telegram announcing Dr G Struve's observation of the new planet, to which reference was made in NATURE of Mar 29, p 507, was received at the Royal Observatory, Greenwich, by telephone; through an error, the word 'planet' was taken down as 'comet' The writer of the note in NATURE learnt of the mistake and immediately communicated with the Editor, requesting the deletion of the words "who called the body a comet" Instructions were telegraphed to the printers, but the message was misunderstood, and the words appeared. Apologies are due to Dr Struve for the misrepresentation

Research Items

Indian Chronology—In the *Indian Antiquary* for February Mr F J Richards outlines a scheme of periods in Indian history which was originally put forward and discussed at a meeting of the Indian Section of the Royal Anthropological Institute The object of the scheme is to correlate the periods of the historian with the ebb and flow of culture both inside and outside India. The historic period is divided into three 'major' divisions (1) The Early, 600 B C to A D 300, (2) the Medieval, A D 300 to A D 1500, and (3) Modern, A D 1500 to A D 1900 Each of these is again subdivided into three For the early period the suggested division is (I) 600 B C to 300 B C, (II) 300 B C to 1 B C, and (III) 1 B C to A D 300 Of these, I, 600 B C to 300 B C, roughly answers to the Hellenic period of Europe, the Achæmenid period of Persia and the close of the Chou dynasty of China In northern India it covers the rise of Jainism and Buddhism and the consolidation in the lower Gangetic plain of the kingdom of Magadha Foreign influence is represented by the Persian conquest of the north west in 512 B C and the invasion of Alexander From 300 B C to A D 300, roughly the period of Hellenistic Greece and imperial Rome, covers in India the Mauryan empire at its zenith under Asoka and its partition between Sungas, Andhras and Greeks from Bactria, and at a later stage Sakas and Pahlavas from Iran, and secondly the rise and decline of the Kushan empire Southern India is obscure, but Roman traders were busy in Malabar As regards foreign contacts, the Mauryas were in touch with Greece, and the Kushans with Rome, but the main thrust came from China In the period A D 300 to A D 650 when in Europe imperial headquarters were transferred to Constantinople, in northern India the 'Gupta period' falls into two phases with the Huna invasion (480 to 528) The period 650 to 1200 covers the struggle between the Byzantine Empire and Islam, and the second great expansion of China under the T'ang dynasty and the struggle with the Tartars In India it answers to the Rajput period, a period of conflicting States around Kanauj The period from 1200 to 1500, the closing epoch of the Roman empire and of Mongol domination in Asia, witnesses two phases in the Delhi sultanate, but in southern India interest centres in the Chalukyas of the western Deccan

Mammals formerly eaten in the Dominican Republic—The examination by Gerrit S Miller of the remains of mammals from the food refuse of Indians, Spaniards, and an extinct owl left in the coast region of the Dominican Republic, has afforded interesting evidence of the presence of species now extinct, as well as of the peculiar tastes of the feeders Nineteen species are represented, and although none is new to science, new light has been thrown upon the characters and distribution of some The presence of a ground sloth is demonstrated in this recently extinct fauna, and there have been identified four of the native mammals, the hutia, the quemi, the mohuy, and the cori, which Oviedo y Valdés, the first European chronicler of West Indian history, stated about 1546, were habitually eaten by natives and Spaniards during the early years of the sixteenth century (*Smithsonian Misc Coll*, vol. 82, No. 5, 1929).

Polydactyly in Fowls.—The extra toe in fowls was first shown by Bateson to behave as an irregular dominant in inheritance, following the rule regularly in some families but being transmitted sometimes through normals without an extra toe The extra toe is also known to vary in size and in its freedom from the next Bond has shown that in cases of asymmetry it occurs more frequently on the left than the right foot Punnett and Pease (*Jour of Genetics*, vol 21, No 3) have summarised the evidence on this subject and added some fresh data which are in accord with earlier results They conclude that there is probably a definite factor for polydactyly, and that normals may transmit polydactyly owing to the presence of one or more factors which inhibit its expression In some families, the F_1 are all polydactylous, the F_2 giving 3 1, and the back-cross a 1 1 ratio This was especially true of the light dorking crosses Moreover, out of 142 polydactylous chicks, only 7 showed any degree of asymmetry The silky crosses gave more exceptions It is suggested that certain 4 toed birds may really represent double asymmetry, factors being present which suppress both the right and left extra toe Normal birds from a polydactylous parent sometimes in crosses with polydactyls give a high number of birds without an extra toe Such normals are spoken of as 'resistant', and the evidence indicates that this condition is mainly due to the presence of one inhibitor In certain cases, however, another factor must also be concerned in inhibiting the appearance of the extra toe There is no evidence of linkage between polydactyly or asymmetry and sex

Polyzoa—The presidential address to the Linnean Society delivered by Sir Sidney Harmer on May 24, 1929, on Polyzoa, has recently been issued (*Proc Linn Soc*, Session 141, 1930) In the first four sections all zoologists will find much of interest since they deal with the group in general, its economic importance, and early chapters of its history finishing with those connected with the names of Linné and Ellis The latter had remarkably clear ideas on the Polyzoa for the time in which he worked In recent years, a great deal of important work has been done on these animals by Jullien, Levinsen, Borg, and the author himself, the greater part of which has not yet found its way into the ordinary text books and so is familiar only to those who have worked in the same field These investigations have added greatly to our knowledge of the morphology and physiology of the group, and consequently modified its classification extensively Sir Sidney Harmer has reviewed this work in a critical manner and provided a clearly illustrated account of its most important results In the concluding pages is a discussion of the most recent classification that has been put forward by Borg The whole forms an interesting and useful essay for which the author deserves the thanks of his colleagues

Fresh-Water Crustacea of Norfolk—Dr Robert Gurney (*Trans Norfolk and Norwich Nat Hist Soc.*, vol 12, part 5, December 1929) gives a general survey of the fresh water Crustacea of Norfolk. He considers the plankton of the Norfolk Broads belongs generically to the Baltic type, but it has marked specific differences attributable partly to marine influence and partly to the factors of depth, size, and climate The shallow weed grown Broads are extraordinarily rich in Entomostraca but the richness depends to a large extent on the nature of the vegetation and the salinity of the water In general, the crustacean fauna is characterised by its great variety and the absence of all northern forms Of the river crustaceans the most interesting is *Leander longirostris*, the 'white prawn' or 'jack shrimp', recorded for the first time as a British species in 1921, and now known to occur

also in the Tamar in Devonshire This prawn is almost as much at home in fresh water as in salt water, its range of tolerance being much greater than that of *Palæmonetes varians*, which is very sensitive to water of low salinity The jack shrimp, however, goes to the sea to hatch its young, and indeed its eggs will not hatch in fresh water, while the larvæ of *Palæmonetes* thrive in brackish water The author does not accept the view that *Cordylophora lacustris* and *Dreissensia polymorpha* are two species actually in process of migration from the sea to fresh water *Dreissensia* is very definitely a fresh water species quite intolerant of salt water and there is no evidence that it has changed its habits in historic times *Cordylophora* is not an estuarine or even a brackish water form, and its distribution does not indicate recent penetration from the sea

Fauna of Sinai —The results of an expedition to the Sinai Peninsula in 1927, under the auspices of the Hebrew University of Jerusalem, have recently appeared as a small volume edited by Drs F S Bodenheimer and O Theodor and published by J C Hinrichs'sche Buchhandlung, Leipzig, 1929 (price 12 gold marks) The editors contribute general articles on the climate, topography, geology, etc , of the Peninsula, but the greater part of the book is devoted to the insect fauna Probably the most interesting chapters are those devoted to the manna produced on tamarisk the history of the subject, the insects responsible for the manna production, and the chemical composition of the latter being discussed There are also separate articles by specialists dealing with the Orthoptera, Coccidæ, and Formicidæ collected by the expedition With reference to the Orthoptera, it is noteworthy that the only previous account of these insects from the Peninsula is that of Krauss published in 1909 In the present collections one new genus and four new species are described, and there seems little doubt that a thorough exploration of the Sinai Orthoptera would throw considerable light upon the origin and evolution of the desert fauna generally The report, it may be added, is well illustrated by text figures and half-tone plates

Cereal Breeding —Dr E S Beaven, chairman of the Council of the Institute of Agricultural Botany, made some interesting comments upon the work of the Institute at the meeting of its Council in December 1929, which received the tenth annual report Referring particularly to the work of the Crop Improvement Branch, he pointed out that originally emphasis was laid, in the statement of the aims of the Institute, upon the growth and marketing for the trade of new varieties He points out that, as a matter of fact, in ten years the Institute " has only distributed one new variety and that was only a modified form of an older variety already in cultivation" Dr Beaven, from his long practical experience of cereal breeding, had anticipated this situation, in view of the fact that it was the Institute's declared policy " to market no new variety unless there is clear proof of its superiority to races already in cultivation in respect of probable monetary value to growers " Dr Beaven pointed out the practical significance of another task carried out by the Institute " the testing by systematic and repeated trials at our headquarters and sub-stations in six different locations—all in corn-growing areas—of the relative merits of different races of farm plants " Dr Beaven also dealt with the practical question of the return for the outlay upon work of this type carried out by the Institute. The records of the Institute's trials show that there are frequently differences of 10-20 per cent in the values of the crops due to the variety or race of seed sown Dr Beaven added · " It is a modest estimate that something over 5 per cent would be added to the monetary return of the arable farmers of the country if they all grew the races of plants best suited to their localities and soil conditions That would add about £2,000,000 every year to the net returns for arable farm produce "

Earth-Tiltings before Earthquakes —Two interesting papers have recently appeared on the tilting of the ground before earthquakes in Japan Messrs W Inouye and T Sugiyama have examined the records for nearly two years, 1927–29, of a pair of tiltometers erected at the seismological station half way up Mt Tukuba (*Proc Imp Acad* , Tokyo, vol 5, pp 457 459 , 1929) The vector diagrams show that the earth tiltings exhibit an annual variation probably connected with changes of air temperature From time to time, this regular variation is disturbed by irregular fluctuations of short period during which the earthquakes of the district usually occurred The centres of two of these earthquakes were close to Mt Tukuba Before each shock, earth tiltings were more or less pronounced for a month or more and they ended simultaneously with its occurrence Prof A Imamura and Mr T Kodaira have made similar observations on the tiltings before the Kii earthquake of July 4, 1929 (*Proc Imp Acad* , Tokyo, vol 5, pp 460-462 , 1929) The earth tiltings at Tanabe, 12½ miles from the epicentre, showed that the regular annual variation was interrupted by a ' tilt storm ' on June 20 This lasted until July 3, when the tiltings returned to normal conditions, the earthquake occurring on the following day The authors of both papers conclude that the abnormal tiltings observed were actual precursors of the earthquakes

A Grating Periodograph —An interesting application of the methods of pure science to an important industrial problem is described in the January number (vol 21) of the *Journal of the Textile Institute*, which contains a paper by G A R Foster on " The Grating Periodograph for the Analysis of Series of Observations for Hidden Periodicities " Though the procedure described is applicable to the analysis of any series of observations in which periodicities are suspected, it has been developed at the Shirley Institute, the headquarters of the British Cotton Industry Research Association, expressly for the purpose of detecting periodic variations in the dimensions and properties of cotton yarns as produced under various manufacturing conditions Briefly, the method consists of throwing an image of the graph to be tested, via a grating, on to a ground glass screen or photographic plate If the area under the curve has been previously blackened out, there are formed, at certain distances of screen and grating, bands of light and dark fringes of spacing simply related to the hidden periodicities of the curve Both the practical details and the theory of the method are given It is undoubtedly a simple and elegant way of carrying out a periodogram analysis, which furthermore allows Schuster's method of secondary analysis to be performed in a very convenient manner

Illumination Requirements —A statistical analysis of the requirements in artificial light of the average American family was recently presented before the New York section of the American Institute of Electrical Engineers The authors commenced by analysing needs in regard to ' work illumination ' (reading, writing, sewing, factory work, etc), ' social illumination ' (in the home, places of public assembly, etc), and ' utility illumination ' (passages, store

rooms, streets, etc) For these the following values of illumination (foot candles) are suggested

	Activities requiring—		
	Work Illumination	Social Illumination	Utility Illumination
A Minimum present good practice	15	5	3
B Minimum recommended	30	10	5
C Probable levels of greatest economic advantage	50	15	5
D Possible desirable levels from eye considerations only	300	50	30

An attempt is next made to determine the 'light hour' needs of the average family and hence the possible total demand for electrical energy for light in the United States The estimate based only on consideration of the eye (*D*) attains the prodigious total of 778,900 millions of units a year It appears that the total actual consumption of electricity for lighting in 1929 was about 20,000 million units It is estimated that at the levels in the above table the saturation is respectively 30, 17, 13, and 3 per cent

Conduction of Electricity in Metals —On the classical electron theory of metals, the exact hypotheses made concerning the type or absence of directed motion of the electrons were often not of great importance for the final description of any particular effect This result, which, although scarcely to be expected, was frequently useful, has now been shown by T E Stern, in a paper in the March number of the *Proceedings of the Royal Society*, to be closely connected with the fact that on classical theory the kinetic energy of the electrons is a linear function of their density On Prof Sommerfeld's theory, in which the electrons are treated as a degenerate gas, the linear dependence of energy upon density disappears, and with it the equivalence of the different methods of analysis The properties of a metal which is passing a current cannot be safely deduced from those of an insulated metal, without making careful inquiry as to the nature of the phenomenon in question, a general result which is illustrated by the special cases of the Thomson effect, the evaporation of electrons, and some others Mr Stern also raises the question of the applicability of thermodynamical reasoning, such as was applied by Kelvin to the thermoelectric circuit—a problem also recently treated by Bridgman—but shows that Sommerfeld's formula for a thermal electromotive force is in at least approximate accord with Kelvin's results Mr Stern's conclusions, although expressed in terms of the present electron theory of metals, are not entirely dependent on this, but retain their main features for any theory in which the kinetic energy is not proportional to the density

The Kennelly-Heaviside Layer —The Radio Research Board has issued a report of the work carried out from the foundation of the Board until March 1929 It is the first of a series of annual reports We learn that four committees have been appointed to study the problems connected with the propagation of radio waves, atmospherics, directional radio, and thermionic valves respectively In each of these committees radio physicists and practical engineers are adequately represented It is stated that the most important result obtained in the study of wave propagation is the direct experimental proof of the existence of the Kennelly Heaviside layer Observations under Prof E V Appleton's supervision were made at King's College, London, and at Cambridge and Peterborough with the primary object of investigating the effects of ionisation of the atmosphere on signal fading and the propagation of waves in general Considerable use was also made of a second method in which the variations of signal strength in a loop and vertical aerial are compared Transmissions on waves of 100 metres length from the National Physical Laboratory were observed simultaneously at the three stations Downcoming waves were detected at King's College, only eleven miles from the transmitter, almost as easily as they were detected at Cambridge and Peterborough This indicates reflection on this wave length at almost vertical incidence The results obtained from the three stations show very close agreement The height at which deviation of waves takes place appeared to be normally 50 70 miles, but on many occasions in the middle of the night the height was found to be 130 180 miles On such occasions the lower region is re formed after sunrise and lower heights from 50 miles to 70 miles in height are again found Day observations indicate that a third ionised region exists beneath the reflecting layers, which, however, merely attenuates the waves

Equilibria in Sulphur Dioxide Solutions —In spite of the fact that sulphur dioxide is such a well known compound, there is surprisingly little information in the literature as to the properties of its aqueous solutions In the January number of the *Canadian Journal of Research* (National Research Council of Canada), which contains several other interesting communications, there is a study by W B Campbell and O Maas of the equilibria in solutions of sulphur dioxide, which has a bearing on the sulphite cellulose industry They point out that the sulphurous acid behaves as monobasic even at high dilutions, so that SO_2, H_2SO_3, $H^{\cdot}$ and HSO_3' are the constituents concerned The proportion of H_2SO_3 decreases rapidly with rise of temperature, whilst the true ionisation constant $K = [H^{\cdot}][HSO_3']/[H_2SO_3]$ is 0 03 and does not change much with temperature Experiments on vapour pressures, densities, and conductivities of solutions of concentrations up to 8 per cent and temperatures to 110° are described which extend the results just stated These show that sulphurous acid is a strong acid, the apparently weak character being due to lack of hydration of sulphur dioxide in solution

Ignition of Carbon Monoxide —It is well known that the ignition of a mixture of carbon monoxide and oxygen is greatly promoted by the presence of small amounts of water vapour or of hydrogen In the February number of the *Journal of the Chemical Society*, Smithells, Whitaker, and Holmes describe experiments in which the efficiencies of hydrogen and water vapour are compared by passing a spark through two eudiometers in series, one containing the carbon monoxide-oxygen mixture with hydrogen and the other the mixture with water vapour in equimolecular amount When the drying of the carbon monoxide-oxygen mixture had not been greatly prolonged, it was found that hydrogen was more effective than water vapour, the estimated minimum quantities being 0 03 per cent and 0 12 per cent With more intense drying of the combustible mixture, the activity of the hydrogen was altogether inhibited In other words, the superior catalytic effectiveness of hydrogen was in its turn conditioned by the presence of a minimal quantity of water vapour It may equally well be said, alternatively, that in the presence of hydrogen a minimal quantity of water sufficed to confer ignitibility

The Pine-Sawyer Pest in Sweden.

IN No 25 of *Meddelanden från Statens Skogsförsöksanstalt*, 1929 (Reports of the Swedish Institute of Experimental Forestry), Ivar Trägårdh has a paper on the injury caused by the pine sawyer (*Monochammus sutor*, L) in Sweden and its prevention (" Om Tallbookens Skadegörelse och Bekämpande ")

It is a remarkable fact that, even in parts of Europe (it is of course more easily comprehensible in great tropical regions), so little should have been known until comparatively recently of some of the injurious forest insect pests, especially certain families and genera of beetles In his paper the author states that " some ten years ago very little was known about the pine sawyer and its economic importance in Sweden It is true that since the days of A E Holmgren it was considered a common but indifferent insect, and it was not known that the data given by Holmgren regarding the wood boring activity of *Acanthocinus aedilis* is in reality referable to the pine-sawyer "

Trägårdh published his studies on this latter longicorn in 1918, his investigations having shown that owing to the galleries penetrating deep into the wood the insect was capable of causing serious losses in timber These investigations especially led to the establishment of the fact that the ravages by this pest, after a forest fire, were very serious—" One of the most astonishing facts in the biology of the pine sawyer is its regular and extremely prolific occurrence after forest fires This is partly due to the fact that in Sweden forest fires as a rule break out at the end of June and the beginning of July just before the breeding season of the pine-sawyer But this does not explain the reason why thousands of trees a few weeks after a forest fire should be infected to such an extent that one may find as many as 100 eggs per m It seems evident that the sense of smell in the pine-sawyer is very keen and that the beetles are attracted from regions several miles away whither the reek of the forest fire is carried by the wind "

It is not certain that all authorities would agree with the author that it is the sense of smell which attracts longicorn beetles to trees in the condition they require for oviposition In the case of *Hoplocerambyx spinicornis*, the now well known serious pest of the sal (*Shorea robusta*) forests of India, Stebbing (*Ind For Insects*) attributes the power of unerringly discovering suitable trees to instinct, pointing out that a newly felled green tree will be discovered and infested within twenty four hours It is an interesting point which requires, if it is at all possible to institute them, further careful observations

Trägårdh has a number of useful observations in this paper anent longicorn groups in general, their habits of oviposition, the feeding capabilities of adult beetles and those of the larvæ, the methods of pupation and so forth The paper and the illustrations merit a careful study—for it appears undeniable that the powers of this family of beetles for destruction in the forest itself, and havoc to the timber after the trees have been felled, are equally as serious (if not more so) in sub tropical and tropical forests as is the case in European temperate ones

Geological Climates

THE meeting of the Royal Society on Mar 27 was devoted to a discussion of the subject of geological climates, which brought out several points of great interest, and showed that the conflict of views, though still considerable, is less direct than it was some years ago In opening the discussion, Dr G C Simpson defined the problem from the point of view of a meteorologist, and laid down some fundamental principles with which all reconstructions of past climates must conform He pointed out that the earth being approximately a sphere rotating on an axis inclined at an angle of about 66½° to the plane of the ecliptic, there must always have been climatic zones in which the mean annual temperature decreased from the equator to the poles, and there must always have been summer and winter

Dr Simpson then passed to the conditions existing at present, and showed that in spite of the great differences in the land and sea distribution of the two hemispheres, the mean annual temperatures of corresponding latitudes between the equator and 70° nowhere differ by more than 3° C From this he drew the conclusions that the mean temperature in any latitude is almost entirely independent of the distribution of land and water, and that the mean temperature of corresponding latitudes is always the same in both hemispheres Hence it is impossible to explain great changes of climate in geological periods by means of changes in the distribution of land and sea The reason is that the gradient of temperature from equator to poles is controlled by the strength of the atmospheric circulation, an increase of the gradient is automatically followed by a strengthening of the circulation, and more heat is carried from the equatorial to the polar regions until the balance is restored The supposition that large ice sheets could exist at sea level in the tropics, while tropical conditions prevailed in middle latitudes of the northern hemisphere, is quite untenable The only way in which major climatic changes could be brought about was by changes of solar radiation, and these had more effect on the cloudiness and precipitation than on the temperature Extensive changes of mean annual temperature could only be brought about by movements of the crust relative to the poles, in the manner described by Wegener

The subsequent discussion turned mainly on two points, the value of fossil plants and animals as indices of past climates, and the power of changes in the distribution of land and sea to modify the zones of temperature and introduce major climatic variations Prof A C Seward said that the climatic value of fossil floras has been greatly overestimated in the past, and there is now no justification for speaking of the climate of the earth as having been uniform or of high northern latitudes as having been tropical It is not possible to infer the climate from a study of extinct genera or even species, because to day allied species often live under quite different climatic conditions Moreover, in the course of ages, plants may have altered their constitution as they passed from youth to senility New plant types frequently originate in arctic regions and spread southward, while in high latitudes they are driven out by the competition of later types, but this does not necessarily imply a change of climate The vegetation of past ages was more uniform than that of to-day, but the uniformity has often been exaggerated, because the early floras consisted exclusively of gymnosperms, which resemble each other much more closely than do flowering plants There is no justification for the assumption that the vegetation of the coal-measures was tropical, on the other

hand, the presence of glaciers does not necessarily imply temperatures at freezing point, for glaciers in New Zealand still end among vegetation of sub tropical aspect

Prof J W Gregory illustrated another difficulty in the interpretation of fossil floras by showing how a coal bed may be in process of formation in Jan Mayen at present, the material being supplied by timber drifted from Siberia

Sir Peter Mitchell agreed with Prof Seward that the climatic value of fossils has been over estimated, since animals have power to adapt themselves to changing climatic conditions He added that for animal life the range of temperature is more important than the annual mean, and the annual range is closely dependent on the distribution of land and sea

These modifications of the former claims of palæontologists concerning past climates represent a great advance towards the meteorological view of the permanence of climatic zones, put forward by Dr Simpson The gap is not entirely bridged, however, for several speakers expressed the opinion that while there must always have been zones of temperature, Dr Simpson has under estimated the possible effects of changes in the distribution of land and sea Prof Gregory referred to a dictum by Lord Kelvin, that if the greater part of Europe, Asia, and North America were submerged beneath the sea, the Arctic Ocean would be free of ice, and an island at the north pole would have a mild climate Dr C E P Brooks referred to investigations by Prof Kerner and himself which led to the same conclusion, and described the transfer of heat by ocean currents, especially in the Atlantic He pointed out that the North Atlantic between 30° N and the Arctic Circle is, on the average, about 5° C warmer than the South Atlantic between 30° S and the Antarctic Circle This difference is almost entirely due to the fact that two thirds of the warm equatorial water is carried into the North Atlantic by the Gulf Stream and Antilles Current In many of the geological periods the distribution of land and sea, according to the usual palæogeographical reconstructions, was such that the whole of the warm equatorial water was diverted into the northern hemisphere, and he argued that under such conditions the oceans of the northern hemisphere must have been much warmer than those of the southern hemisphere, and the thermal equator must have been well to the north of the geographical equator Finally, Dr C Tate Regan described the distribution of fresh water and marine fishes during the Cretaceous and Eocene, which does not fit in with the drift of the continents as inferred by Wegener

The general result of the discussion may be summed up by saying that the geological changes of climate have not been so great as was at one time supposed, but there is not yet any agreement as to whether they were small enough to be accounted for by ordinary agencies, or whether they were on a sufficient scale to necessitate an appeal to movements of the continents relative to the poles

University and Educational Intelligence.

CAMBRIDGE —The Appointments Committee of the Faculty of Economics and Politics has reappointed P Sraffa, of King's College, University lecturer in economics

The Appointments Committee of the Faculty of Biology A has appointed H Gilbert Carter, of Trinity College, to be University lecturer in botany

Smith's Prizes have been awarded to R. E A C Paley, of Trinity College, and J. A Todd, of Trinity College Rayleigh Prizes have been awarded to W R Andress, of Trinity College, and L C Young, of Trinity College

LONDON —Dr Morris Ginsberg has been appointed as from Aug 1 to the Martin White chair of sociology tenable at the London School of Economics He has been University reader in sociology at the School since 1924, and has published articles and books on the science of sociology

The title of 'Professor in the University of London' has been conferred on the following members of the professorial staff of the Imperial College of Science and Technology Profs H B Baker, V H Blackman, W A Bone, W Brown, Sir Harold C H Carpenter, S Chapman, A E Conrady C G Cullis, S M Dixon, C L Fortescue, A Fowler, P Groom, J W Hinchley, H Levy, E W MacBride, J C Philip, A F C Pollard, A O Rankine, J F Thorpe, S J Truscott, Sir Gilbert Walker, W W Watts

It has been resolved to institute a University chair of physics tenable at the Imperial College—Royal College of Science

ST ANDREWS —The Senatus Academicus has resolved to confer the honorary degree of LL D on Mr James Morton, chairman and governing director of the Scottish Dyes, Ltd, and on Prof O W Richardson, Yarrow research professor of the Royal Society, at the graduation ceremonial to be held on June 27

WALES —The agreements between the University of Wales, University College, Cardiff, and the Cardiff Royal Infirmary, which establish the Welsh National School of Medicine as a separate school of the University, were ratified at a meeting of the University Court held at Cardiff on Mar 28

A MATHEMATICAL Colloquium, under the auspices of the Edinburgh Mathematical Society, will be held at the University Hall of St Andrews on July 19–30 The courses arranged include the following Rational curves and surfaces (Prof H F Baker), arithmetical properties of curves and surfaces (Mr H W Richmond), the wave mechanics (Prof C G Darwin), elementary mathematics from the higher standpoint (Prof H W Turnbull), and recent developments in symmetric functions, determinants, and algebraic equations (Dr A C Aitken), Prof E T Whittaker and others will give informal talks Particulars can be obtained from the honorary secretary of the Colloquium, Dr E T Copson, 144 North Street, St Andrews

THE University of Leeds records in its report for 1928–29 a number of important developments, marking, to quote the wording of the report, the opening of a new chapter in its history Among these are the laying of the foundation stone of a new mining block, the opening of a new wing of the textile department, the adoption of a plan for a pathological institute, the construction of a new hostel for men students, the creation of a Montague Barton chair of industrial relations, the conclusion of a reciprocal arrangement with the University of Reykjavik in Iceland for exchange of students, and the acquisition of a very valuable collection of Icelandic books The number of full time day students attending during 1928–29 was 1385, and of part-time 144, evening students numbered 223 Along with the report we have received a forty page pamphlet containing a list of publications by members of the University in 1928–29 and titles and abstracts of theses accepted for higher degrees in science (12), medicine (5), and technology (8)

Historic Natural Events.

April 7, 1408 End of Severe Winter—The winter of 1407–8 was one of the coldest of the past thousand years The great rivers of western and central Europe and the Swiss lakes were frozen for a month or more, and the ice was five or six feet thick The frost began on Nov 11 and continued until Jan 30, then, after a brief respite, it re commenced on Feb 15 and did not break until April 7 The cold was so great that the roots of the vines and fruit trees froze The water-mills were stopped, and there was a great shortage of bread as well as a lack of fuel In France the thaw of Jan 30 caused great destruction of bridges by floating blocks of ice The North Sea was said to be frozen between Denmark and Norway In Great Britain, Holinshed records that "this year the winter was exceeding sharp through frost and snow that continued and covered the ground by all the months of December, January, February, and March, insomuch that thrushes, blackbirds, and many thousand birds of the like smaller size perished with very cold and hunger"

April 7, 1420 Early Season—According to the *Journal d'un Bourgeois de Paris*, 1405–1449, at Pasques the roses were already in bloom on April 7, and were all over by May 15 At the beginning of May good cherries were on sale, and at the end of May the corn was more ripe than the preceding year's crop had been on St John's day (June 24)

April 8, 1233 Mock Suns—According to Miss Ormerod's collection, between 6 A M and 7 A M "in the parts about Hereford and Worcester there appeared four suns in the element, beside the natural sun of red colour and a great circle of crystalline colour, the which compassed with his largeness as it had been the whole circuit almost of the whole realm of England, from the sides whereof went forth certain half circles, in whose sections appeared the said four suns"

April 8, 1709 Baltic Frozen—The early months of 1709 were excessively cold in Europe, and the Baltic was still frozen and snow covered so late as April 8 The frost began between Jan 3 and 5 with a north east wind over all central and western Europe, from Stockholm and Riga to Naples and Cadiz Even the Ebro was frozen The greatest cold occurred from Jan 11–13 and Feb 24–26, but the winter was more notable for duration than for extreme severity In France the people suffered severely from hunger, and roots were eaten instead of bread In Italy the ground was deeply frozen and the olives perished, the lagoon of Venice was frozen more than a mile from shore In England the winter lasted three months, but was not exceptionally severe, and in Ireland and Scotland it was comparatively mild

April 10, 1446 Storm Flood—A terrible storm broke over western Germany, France, Holland, and Switzerland, with violent thunder, very heavy snow, and deadly cold At the same time there was a severe storm-flood in the North Sea, by which sixteen towns were submerged and about 100,000 men drowned This catastrophe was followed by a period of very cold and windy weather, especially severe from April 29 to May 10

April 10, 1657 Flood—The village of Langtoft in Yorkshire, encircled by hills, was flooded to a depth of eight feet, as shown by a memorial stone placed in one of the houses

April 11–12, 1815 Eruption of Tomboro—A volcanic eruption, one of the most violent known, began on April 5 in the island of Sumbawa (to the east of Java), culminated on April 11–12, and continued until July Out of a population of 12,000 in the province of Tomboro, only 26 survived. The sounds of the explosions were heard in Sumatra (1118 miles) and in the opposite direction at Ternate (830 miles) In Java, the darkness caused by the ashes was deeper than on the darkest night The coasts of Sumbawa and the adjoining islands were swept by a sea wave 2 12 ft. in height.

April 11, 1917 Mirage—It is recorded in the "Official History of the War, Mesopotamian Campaign", vol 3, p 316, that Gen Cayley's force had a Turkish division in front of them in a position almost destitute of cover, but they were completely hidden from view by a mirage, and fighting had to be temporarily suspended

April 12, 1527 Long Continued Rains—It rained in England every day or night from April 12 to June 3, and in May it rained 30 hours continuously, which caused great floods and much damage to the crops

April 12–15, 1920 Gale—The weather was extremely unsettled during April 1920, and at some stations the average barometric pressure for the month was the lowest on record during April An especially deep depression lay off south west Ireland on April 11–14, after which it moved north eastward, and on April 15 a wind velocity of 110 miles an hour at a height of 3000 feet was shown by a pilot balloon ascent at Lympne With high pressure over north west Africa, a violent westerly gale occurred in the Straits of Gibraltar, the wind velocity at 1 P M on April 12 being estimated as 68 miles per hour

Societies and Academies

London

Society of Public Analysts, Mar 5—S Judd Lewis (1) The spectroscopic investigation of jams An ethereal extract was examined, using a special form of sector photometer and a spectroscope 'Absorption curves' having extinction coefficients for ordinates and wave lengths for abscissæ, were disturbed by the presence of small amounts of foreign ingredients, such as benzoic acid, salicylic acid, saccharin, certain colouring matters, etc—(2) A simple polarimetric test for sugars in jams A modification of the method of determining the specific rotation of an aqueous extract of the jam, after inversion of the dissolved sugars, is described

Linnean Society, Mar 6—Sidnie M Manton Notes on the segmental excretory organs of Crustacea (5) On the maxillary glands of the Syncarida Detailed reconstructions of the maxillary glands of *Paranaspides*, *Anaspides*, and *Koonunga* have been made from fresh material obtained in Tasmania The general disposition of the coils of the efferent duct in the maxillary glands of the three types is similar, but there are differences in detail The pattern of the duct shown by *Anaspides* and *Koonunga* could have been derived from a type resembling that of *Paranaspides* in general form, but lacking its peculiar features, such as excessive duct fenestration—Major R W G Hingston In the canopy of the forest (British Guiana) An outline was given of the methods adopted by the recent Oxford University British Guiana Expedition to explore the tropical rain forest The party worked in a small area of forest on the right bank of the Essequibo River, about fifteen miles above Bartica. One of the chief objects of the expedition was to get into the canopy of the forest and to study at close quarters the life found to exist in it Hitherto our knowledge of the canopy life consisted in what could be shot from it with a gun or observed in it with binoculars from the ground Ascents were made in four places Access to the canopy was obtained either by

rope ladders or by a seat that could be hoisted on a block-and-tackle Observation posts were fixed in the canopy and rope ladders were spread in the branches, which permitted some freedom of movement in it From the collections made at different levels it is considered that a tropical forest should be regarded as consisting of strata of life spread out one above the other

Optical Society, Mar 13—T Smith Imagery around a skew ray The usual criterion by which conjugate points are defined fails unless neighbouring rays intersect in both object and image spaces The criterion is extended to include the points of nearest approach of non intersecting rays The relation connecting conjugate points is, then, of the same form as for the simpler cases generally recognised The coefficients which determine the imagery are elements of a square matrix of the fourth order A more natural matrix for refraction in three dimensions would be of the sixth order The coefficients of the eikonal and characteristic function can be derived from the elements of either type of matrix—R A Sampson The purpose and design of the new equipment at the Royal Observatory, Edinburgh (see NATURE, Mar 22, p 467)

EDINBURGH

Royal Society, Mar 17—Lt-Col L M Davies The genus *Dictyoconus* and its allies A review of the group together with a description of three new species from the Lower Eocene Beds of northern Baluchistan Numerous specimens of *Dictyoconus*, *Coskinolina* and *Lituonella* mixed indiscriminately together were found within the same narrow limestone bands The differences between these genera are shown to be confined to the peripheral portion of the test, sections reveal the closest agreement in their internal characters as a whole, their generic characters alone affording the means for distinguishing between them These Indian forms are regarded as affording clear evidence of the close affiliation of these three genera They are the first representatives of their respective genera to be found so far east, and are very similar to such western forms as *Dictyoconus egyptiensis* (Chapman), *Coskinolina liburnica* Stache, and *Lituonella roberti* Schlumberger and Douvillé—F Walker The doleritic isles of the North Minch The small islands in the Minch to the north of Skye include the Shiant and Fladda groups They are all composed of crinanite sills with 'schlieren' of syenite, essexite, and teschenite, and in some cases with floors of picrite The alkaline bands and ultrabasic floors are thought to be the result of crystallisation differentiation The sills are doubtless the continuation north of the well known Trotternish examples—**William J McCallien and Robert B Anderson** The Carboniferous sediments of Kintyre Carboniferous sediments in Kintyre form the Machrihanish coalfield, west of Cambeltown The rocks and structure of the coalfield are described and the positions of eight coal seams are indicated on a large scale map A smaller area of coal bearing strata occurs south of the coalfield in Tirfergus Glen An interesting point brought out by the study is the existence of a group of bauxitic clays and laterites at the top of the calciferous sandstone lavas. The coals of the Machrihanish coalfield are correlated with the better known members of the Ballycastle coalfield in Northern Ireland—**William J McCallien** A contribution to the geology of north-eastern Antrim, being an introduction to the correlation of the Dalradian rocks of Scotland and Ireland The following subdivisions of the Dalradian rocks of the south-west Highlands of Scotland have been recognised in north east Antrim Ben Lui schists to the north west, Loch Tay limestone and associated epidiorite, Glen Sluan schists, Green Beds, Beinn Bheula schists The Old Red Sandstone rocks from Cushendun to Cushendall are also described, and a marked resemblance is shown to exist between the Antrim rocks and those of Kintyre This paper indicates a starting point for future correlation of the Dalradian rocks of Ireland and Scotland—D F Martyn A new method of measurement of minute alternating currents The current to be measured is passed through the filament of a diode valve the main heating current in which is an alternating current of the same frequency supplied by an auxiliary oscillating circuit In these circumstances the two superposed currents in the filament settle down into a state in which they are either in the same or in opposite phase Their combined heating effect then depends simply upon the sum or difference of the current amplitudes The effect of the small superposed filament current upon the anode current is measured by a microammeter connected, with a balancing battery, as a shunt across a resistance of several hundred ohms in the anode circuit The value of the current to be measured is then found from the slope of the anode current—filament current characteristic of the valve The method is suitable for the measurement of alternating currents of the order of 1 microampere, the sensitiveness being about the same as that of the microammeter used One great advantage is that it allows each component of a complex oscillatory current (for example, a receiving aerial current) to be measured separately

PARIS

Academy of Sciences, Feb 24—Ch Fabry A new method for the experimental study of elastic pressures A description of a modification and improvement of the optical method suggested by Henry Favre—**André Blondel** Diagrams for the study of the normal running and static stability of connected alternators—Prof A E H Love was elected a *Correspondant* for the Section of Mechanics in succession to the late Sir George Greenhill—**F Marty** The distribution of the values of a meromorph function—**Guichard, Clausmann, and Billon** The influence of the initial state of certain metals and alloys on the variation of hardness as a function of cold hardening For certain alloys the curve of hardness is the same whether the initial state was cast or annealed metal This applies to copper, silver, and copper nickel alloy With copper silver alloys, on the other hand, the limit of hardness depends on the initial state—**L Ravier** The results of experiments on the thrust of soil—**Benjamin Jekhowsky** The calculation for the orientation of the great circle for seeking asteroids—**Maurice Michel** A perpetual calendar giving instantaneously the Julian or Gregorian calendar of any given year—**L Gaurier** The change of the alluvium in lakes converted into reservoirs A discussion of the problems presented by the introduction of considerable quantities of alluvium into reservoirs and the modifications in the shape of the resulting delta by lowering the water level Some actual cases are cited—**A Gruvel** The principal trawling zones of the eastern Mediterranean Fishing map of the gulf of Alexandretta—**L Décombe** The undulatory theory and black body radiation The Planck formula is deduced without recourse to the hypothesis of discontinuity for the energy—**G Foëx** The diamagnetism of the halogen ions Assuming that the diamagnetism of the neutral atoms is due to the superficial electrons, it is concluded, as a first approximation, that the diamagnetism of the ion should be 8/7

that of the neutral atom This is supported experimentally by the results of Weiss, Hocart, and Pascal. For elements other than the halogens, precise numerical data on the diamagnetism of the atom and ion are wanting —**Augustin Boutaric** and **Mlle Madeleine Roy** The radioactivity of various metals obtained from old roofs The authors confirm the results obtained by Mlle Maracineanu in that the exposed faces of old metal sheets taken from roofs are radioactive, and this applies not only to lead but also to zinc and copper roofing Discussing the various possible hypotheses as to the cause of this radio activity, the authors reject the view that the effect is due to a disintegration of the metal under the action of sunlight and consider that the absorption of radioactive emanations from the air and from rain is more probable —**H Muraour** and **G Aunis** The law of combustion of colloidal (explosive) powders —**P Bary** The study of solutions of colouring matters by pectography A plate of glass is placed vertically in a solution of the dye and this is submitted to a slow evaporation The figures formed on the glass plate are termed pectographs and fall into three groups from these, conclusions are drawn regarding the nature of the solution —**Chilowsky** A new method of gasifying heavy oils A method of preheating the air and pulverising the oil is described which, it is claimed, prevents the formation of carbon deposits and reduces the amount of tar formed below one per cent —**Mme Ramart-Lucas** and **F Salmon-Legagneur** The configuration of molecules in space The absorption in the ultra violet of the alkylmalonic acids The study of the ultra violet absorption of the acids of the malonic series leads to a different structure in space being attributed to the monoalkylacids and tho dialkylacids —**M Weizmann** and **S Malkowa** The action of the hydracids on phthalimide epihydrin—**Mme Bruzau** The preparation of some trisubstituted α-arylketones —**V Brustier** The ultra violet absorption spectrum of chelidonine From the analogy between the ultra-violet absorption produced by chelidonine and the alkaloids of the morphine group, it is considered that chelidonine is a phenanthrene derivative rather than a derivative of isoquinoline as suggested by Gadamer —**Georges Brus** and **G Peyresblanques** The fixation of ozone by unsaturated compounds Curves are given showing the velocities of absorption of ozone These give much information on the mode of formation of the perozonides and their polymers —**L Royer** The possible influence of the surrounding medium on the symmetry of the forms of some natural minerals —**Louis Glangeaud** The extension and the facies of the lower and middle Cretaceous in the Atlas coast of the north of the province of Algiers —**René Baillaud** Earthquakes and falls of roof (in mines) —**A Maublanc** and **G Malençon** The nature and the organisation of the gleba of *Battarrea Guicciardiniana* —**Paul Guérin** Hydrocyanic acid in the vetches Its distribution in the various organs of the leguminous Papilionaceæ containing a cyanogenetic glucoside In the cyanogenetic Leguminosæ, the glucoside producing the hydrocyanic acid may, according to the genus, be found localised in quite different organs Examples are given —**Maurice Hocquette**: The influence of the decalcification and of the acidity of coastal sands on vegetation —**Mlle M L Verrier** The structure of the retina of an Aga midæ *Agama Tournevillii* —**D. Santenoise, H Verdier,** and **M Vidacovitch** Pancreatic vagotonine and hepatic glycogen —**J Malassez**. The distribution of energy in the compound colours —**R Lienhart** The genetics of the castorrex rabbit This rabbit is a mutation which appeared in the Sarthe in 1919, the fur of which resembles that of the beaver —**A Lacassagne** The difference in the biological action caused in yeasts by various radiations Comparison of the action of ultra-violet rays, soft X-rays, and the α-rays on the yeast *Saccharomyces ellipsoideus* —**F Holweck** Energy study of the biological action of various radiations —**N Bezssonoff** Vitamin A and carotene —**E Couture** The oxidation of oils in the presence of irradiated sterols —**L Boëz** and **J Guillerm** The microbial factor in the manufacture of Indo-Chinese pickle (*Nuoc-mam*)

Official Publications Received.

British

Report on the Operations of the Department of Agriculture, Madras Presidency, for the Year 1928–29 Pp ii+96+6 plates (Madras Government Press.) 1 rupee.

The Indian Medical Association. Some Problems of the Medical Profession in India Compiled by Kumud Sankar Ray Pp vii+88 Presidential Speech of Dr B C Roy at the All India Medical Conference, Lahore, 27th December 1929 Pp. 10 Address by Colonel Bhola Nauth at the All India Medical Conference held at Lahore on 27th and 28th December 1929 Pp 61 Resolutions passed at the All India Medical Conference, Sixth Session, held at Lahore, 27th and 28th December 1929 Pp. 7 (Calcutta.)

Proceedings of the Royal Society Series A Vol 126, No A803, March 3 Pp. 542 728+xviii+vi (London Harrison and Sons, Ltd) 6s

Report of the Department of Industries, Madras for the Year ending 31st March 1929 Pp vi+108 (Madras Government Press) 12 annas

The Journal of the Royal Technical College being a Record of some of the Research Work carried out in the College by the Staff and Senior Students Vol. 2, Part 2, January Pp iv+151 366 (Glasgow) 10s 6d

Journal of the Marine Biological Association of the United Kingdom New Series, Vol 16 No 2, March Pp. 365 676 (Plymouth) 10s 6d net.

Committee of the Privy Council for Medical Research Report of the Medical Research Council for the Year 1928–1929 (Cmd 3496) Pp 158+2 plates (London H M Stationery Office.) 3s. net

Transactions of the Institute of Marine Engineers, Inc., Session 1930 Vol 42. Pp 103 (London)

The National University of Ireland Calendar for the Year 1929 Pp. viii+275+482+208. (Dublin Alex Thom and Co , Ltd.) 2s

Quarterly Journal of the Royal Meteorological Society Vol 56, No 233, January Pp. 102 (London Edward Stanford, Ltd) 7s 6d.

Colony and Protectorate of Kenya Agricultural Census 1929 Tenth Annual Report. Pp 41 (Nairobi Department of Agriculture.) 2s

Survey of India Professional Paper No. 25 The Representation of Glaciated Regions on Maps of the Survey of India. By Major Kenneth Mason. Pp. 18+4 plates. (Dehra Dun) 8 annas 10d.

Union of South Africa Department of Agriculture. Annual Report of the Director of Veterinary Services, Onderstepoort, Pretoria. 15th Report, October 1929 Vol. 1 (Sections 1 to 4). Pp xiv+578. 10s Vol 2 (Sections 5 to 9). Pp. iv+575 1209 10s (Pretoria Government Printing and Stationery Office)

The South African Journal of Science Vol 26 Being the Report of the Twenty seventh Annual Meeting of the South African Association for the Advancement of Science, Joint Meeting with the British Association, Johannesburg, Cape Town, Pretoria, 1929, 22 July to 3 August. Pp xiii+988 (Johannesburg) 30s net

Union of South Africa Fisheries and Marine Biological Survey Report No 7 for the Year ending June 1929, by Dr Cecil von Bonde, and Special Reports. Pp 62+8 charts+84+8 plates+12+11+19+3 charts (Pretoria Government Printing and Stationery Office)

Paleontologiese Navorsing van die Nasionale Museum, Bloemfontein. Deel 2, Stuk 1 Vrystaatse Fossiele Perde Deur Dr Ir E C N Van Hoepen Pp ii+11 (Bloemfontein.)

Association of British Chemical Manufacturers. Directory of British Fine Chemicals produced by Members of the Association Pp 55 (London) Free.

Department of Agriculture, Trinidad and Tobago. Flora of Trinidad and Tobago Vol I, Part 2 Parietales, Polygalinae, Caryophyllinae, Guttiferales, Geraniales, by R. O Williams, Malvales, by R. O Williams and E. E. Cheesman. Pp. 23-164. (Trinidad Government Printing Office, Port-of-Spain.) 6s.

The Scientific Proceedings of the Royal Dublin Society Vol 19 (N S), No. 32 The Thermal Instability of the Earth's Crust, II By Dr J H J Poole. Pp. 385-408. (Dublin Hodges, Figgis and Co. , London Williams and Norgate, Ltd) 2s.

The Journal of the Institute of Metals Vol 42 Edited by G Shaw Scott Pp. xii+846+48 plates (London) 31s 6d net

The British Gliding Association Journal. No. 1, March Pp. 28 (London) 2s 6d.

Department of Scientific and Industrial Research. Report of the Radio Research Board for the Period ended 31st March 1929 Pp. iv+166+4 plates (London H M Stationery Office.) 3s. 6d. net.

The Journal of the Institution of Electrical Engineers Edited by P F Rowell. Vol 68, No. 399, March. Pp. 317-412+xxxvi. (London E and F N Spon, Ltd) 10s. 6d

Annual Report of the Indian Central Cotton Committee, Bombay, for the Year ending 31st August 1929 Pp. ii+105+3 plates. (Bombay) 2 rupees

Indian Journal of Physics, Vol 4, Part 5, and Proceedings of the Indian Association for the Cultivation of Science, Vol. 13, Part 5. Conducted by Sir C V Raman. Pp. 349-447 (Calcutta.) 1 8 rupees, 2s.

Western Australia Geological Survey Bulletin No. 94: Geology and Ore Deposits of the Boulder Belt, Kalgoorlie. By Dr F L. Stillwell. Pp. 110+17 plates. (Perth Fred. Wm Simpson.)

Memoirs of the Cotton Research Station, Trinidad. Series B Physiology No 2 Studies of the Transport of Nitrogen in the Cotton Plants, Parts 1, 2 and 3 By E J Maskell and T G Mason Pp. 205-231+615 652+29 (London Empire Cotton Growing Corporation) 2s 6d.

British Board of Film Censors. Report, Year ended December 31st, 1929 Pp. 12 (London.)

Researches published from the Warde and Laboratories of the London Hospital during 1929 48 papers (London H. K Lewis and Co, Ltd) 7s 6d net.

Engineering Training for Officer e Rank Report of the Council of the North East Coast Institution of Engineers and Shipbuilders, 14th February 1930 Pp. 15 (Newcastle upon Tyne)

Transactions and Proceedings of the Perthshire Society of Natural Science Vol. 8, Part 6, 1928-29 Pp 265 280+viii+lxi-lxxxii (Perth)

Proceedings of the Society for Psychical Research. Part 114, Vol 39, March Pp. 247 271 (London) 2s.

FOREIGN

Smithsonian Institution United States National Museum Report on the Progress and Condition of the United States National Museum for the Year ended June 30, 1929 Pp. ix+207 (Washington, D C Government Printing Office) 25 cents

Cornell University Agricultural Experiment Station, Ithaca, New York Bulletin 479 The Relationships between Roads and Agriculture in New York. By J L Tennant Pp 84 Bulletin 483 Economic Studies of Dairy Farming in New York 9 Grade B Milk with Cash Crops and Mixed Hay Roughage, Crop Year 1925, with Five year Summary By J C Neethling Pp 93. Bulletin 487 Rural Population, Tompkins and Schuyler Counties, New York, 1925 By Bruce L Melvin Pp 58. Bulletin 489 The Clover-Leaf Caterpillar (*Olethreutes cespitana* Hübner) and the Clover-Leaf Tyer (*Anchylopera angulifasciana* Zeller) By Lawrence Paul Wehrle Pp 27 Bulletin 492 Organization of the Sewing Center in the Home By Ella M Cushman Pp 87 (Ithaca, N Y)

United States Department of the Interior Fiftieth Annual Report of the Director of the Geological Survey to the Secretary of the Interior, 1929 Pp. ii+87+1 plate. (Washington, D C Government Printing Office)

United States Department of the Interior Geological Survey Water Supply Paper 578 The Mohave Desert Region, California, a Geographic Geologic and Hydrologic Reconnaissance. By David G Thompson Pp xi+759+34 plates 2 dollars Water Supply Paper 598 Geology and Ground water Resources of North Dakota By Howard E Simpson With a Discussion of the Chemical Character of the Water, by Harry B Riffenburg Pp. v+312+8 plates 50 cents Water Supply Paper 602 Surface Water Supply of the United States, 1925 Part 2 South Atlantic Slope and Eastern Gulf of Mexico Basins. Pp. iv+107 15 cents Water Supply Paper 603 Surface Water Supply of the United States, 1925 Part 3 Ohio River Basin Pp vii+343. 40 cents Water-Supply Paper 604 Surface Water Supply of the United States, 1925 Part 4 St Lawrence River Basin Pp v+179 25 cents. (Washington, D C Government Printing Office)

United States Department of the Interior Geological Survey Professional Paper 158 C The Helderberg Group of parts of West Virginia and Virginia. By Frank McKim Swartz (Shorter Contributions to General Geology, 1929) Pp 27 75+plates 5 9 20 cents Professional Paper 158 D Petrography of the Pioche District, Lincoln County, Nevada. By Joseph L. Gillson (Shorter Contributions to General Geology, 1929) Pp 77 86+plate 10. 10 cents. Professional Paper 158 E The Varves and Climate of the Green River Epoch By Wilmot H Bradley (Shorter Contributions to General Geology, 1929) Pp 87 110+plates 11-14. 15 cents Professional Paper 158 F Contact Metamorphism of the Rocks in the Pend Oreille District, Northern Idaho. By Joseph L Gillson. (Shorter Contributions to General Geology, 1929) Pp 111 121+plate 15 10 cents. Professional Paper 158-G Early Pleistocene Glaciation in Idaho By Clyde P Ross (Shorter Contributions to General Geology, 1929) Pp 123 128+plates 15 19 10 cents. Professional Paper 158 H The Flora of the Frontier Formation. By Edward Wilber Berry (Shorter Contributions to General Geology, 1929) Pp 129 135+plates 20 21 5 cents. (Washington, D C Government Printing Office)

Sveriges Geologiska Undersökning Ser Aa, No 144 Beskrivning till kartbladet Nyed Av Nils H Magnusson och Gunnar Assarsson Pp. 109 4 00 kr Ser Aa, No. 167 Beskrivning till kartbladet Säffle Av Nils H Magnusson och Lennart von Post Pp. 96. 4 00 kr Ser Aa, No. 170 Beskrivning till kartbladet Katthammarsvik Av Henr Munthe, J Ernhold Hede och G Lundqvist. Pp. 120 4 00 kr (Stockholm)

U S. Department of Commerce Coast and Geodetic Survey Special Publication No 157 Distribution Coefficients of Magnets. By George Hartnell Pp iii+30 10 cents Special Publication No. 159 The Bowie Method of Triangulation Adjustment as applied to the First-Order Net in the Western Part of the United States. By Oscar S Adams Pp. iii+32. 10 cents (Washington, D C Government Printing Office.)

United States Department of Agriculture. Technical Bulletin No 149 Fungous Diseases of the Honeybee. By C E. Burnside Pp 43+6 plates. (Washington, D C Government Printing Office)

United States Department of the Interior Bulletin 1929, No. 88 Record of Educational Publications, comprising Publications received by the Office of Education, January-June 1929. Pp iii+54. (Washington, D C Government Printing Office.) 10 cents

Proceedings of the United States National Museum Vol. 77, Art. 2 New Land and Fresh Water Mollusks from South America. By William B. Marshall. (No. 2825.) Pp 7+2 plates. (Washington, D C Government Printing Office)

Zur Geschichte der Zeissischen Werkstätte bis zum Tode Ernst Abbes. Von Moritz von Rohr Mit Beiträgen von Max Fischer und August Köhler Pp. viii+120+10. (Jena und London Carl Zeiss)

Meddelande från Lunds Astronomiska Observatorium No. 121 Messungen der Höhenstrahlungsintensität zwischen 55 und 70° nord licher geographischer Breite. Vorläufige Mitteilung Von Axel Corlin. Pp 6. Ser 2, Nr 53 Studies on the Proper Motions of Long period Variable Stars. By W Gyllenberg. Pp. 20 Ser 2, Nr 54 The Period Luminosity Curve of Long-period Variables. By W Gyllenberg. Pp. 18. (Lund C W K. Gleerup, Leipzig Otto Harrassowitz)

Memorie della Pont. Accademia delle Scienze. Nuovi Lincei Serie 2, Vol. 13 I Coleotteri d Italia Catalogo Sinonimico-Topografico-Bibliografico Pp. v+1160 (Roma Scuola Tipografica Pio X)

Japanese Journal of Geology and Geography Transactions and Abstracts Vol 7 No 1, October 1929 Pp 42+5 plates Vol. 7, No. 2, January Pp 43 78+plates 5 7 (Tokyo National Research Council of Japan)

Journal of the Faculty of Agriculture, Hokkaido Imperial University, Sapporo Japan Vol. 25, Part 4 Vierter Beitrag zur Ichneumoniden fauna Japans Fünfter Beitrag zur Ichneumoniden fauna Japans, Allgemeine Beschreibung über den Beitrag zur Ichneumoniden-fauna Japans. Von Toichi Uchida. Pp 243 375+plates 4 6 (Tokyo Maruzen Co, Ltd)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. First Series (Mathematics, Physics, Chemistry), Vol 18, No 5, December 1929 Pp. 581 744+4+4 (Tokyo and Sendai Maruzen Co, Ltd) 2 00 yen.

Carnegie Institution of Washington Year Book No 28, July 1, 1928, to June 30, 1929, with Administrative Reports through December 13, 1929 Pp xix+439 (Washington, D C Carnegie Institution)

Division of Fish and Game of California. Fish Bulletin No 18 The Pismo Clam Further Studies of its Life History and Depletion. By William C Herrington (Contribution No. 81 from the California State Fisheries Laboratory) Pp. 69 Fish Bulletin No. 19 Sardine Fishing Methods at Monterey California. By W L. Scofield (Contribution No 84 from the California State Fisheries Laboratory) Pp. 62 Fish Bulletin No 21 Analysis of Boat Catches of White Sea Bass (*Cynoscion nobilis*) at San Pedro, California. By S. S. Whitehead (Contribution No 86 from the California State Fisheries Laboratory) Pp 27 (Sacramento California Government Printing Office)

Proceedings of the United States National Museum Vol 75, Art 14 The Middle Devonian Traverse Group of Rocks in Michigan, a Summary of Existing Knowledge By Erwin R Pohl (No 2811) Pp 34+2 plates. Vol 77 Art. 1 Two new Species of Trematode Worms of the Genus Eucotyle from North American Birds By Emmett W Price (No 2824) Pp 4 (Washington D C Government Printing Office)

U S Department of Commerce Coast and Geodetic Survey Special Publication No. 151 First Order Leveling in Hawaii By Howard S Rappleye Pp iii+21 (Washington D C Government Printing Office) 10 cents

Publications of the Allegheny Observatory of the University of Pittsburgh Vol 8, No 1 Spectroscopic Notes By Kelvin Burns Pp 14 Vol. 8 No 2 a A New Type of Comparator, by Heber D Curtis b A Computing Attachment for Comparators, by Kelvin Burns Pp 15 25+6 plates (Pittsburgh)

Iowa Geological Survey Vol 34 The Pre Illinoian Pleistocene Geology of Iowa By George F Kay and Earl T Apfel Pp 304 (Iowa.)

Japanese Journal of Engineering Abstracts Vol 7 Pp x+74. (Tokyo National Research Council of Japan)

The American Institute of Mining and Metallurgical Engineers. Technical Publication No 315 Absorption of Electromagnetic Induction and Radiation by Rocks By A. S Eve (Class I, Geophysical Prospecting, No 19) Pp 11 (New York City)

The University of Chicago Publications of the Yerkes Observatory Vol. 7, Part 1 Radial Velocities of 500 Stars of Spectral Class A. By Edwin B Frost Storrs B Barrett and Otto Struve Pp vii+79 (Chicago University of Chicago Press London Cambridge University Press.) 6s 9d net.

CATALOGUES

Chemie Physik 10 Verzeichnis antiquarischer und neuer Bücher und Zeitschriften Pp 88 (Berlin Verlag Chemie, G m b.H)

The Taylor Hobson Outlook Vol 3, No 16 March Pp. 145-152 (Leicester and London Taylor Taylor and Hobson Ltd)

Books relating to West Africa. (Catalogue No 528) Pp 32 (London Francis Edwards, Ltd)

Diary of Societies

FRIDAY, April 4

Institution of Chemical Engineers (Annual Corporate Meeting) (at Hotel Victoria, Northumberland Avenue), at 11 30 A.M —Presentation of Medals The Moulton Medal, The Junior Moulton Medal, The Osborne Reynolds Medal.—At 12.15 —J A Reavell The Rôle of Science in Industry (Presidential Address).—At 2 15 —H Tongue The High Pressure Equipment of the Chemical Research Laboratory, Teddington.

Royal Society of Arts (Indian Section), at 4 30 —Lieut -Col Sir Wolseley Haig The Maratha Nation (Sir George Birdwood Memorial Lecture)

Federal Council for Chemistry (at Burlington House), at 4 30.

Society of Chemical Industry (Liverpool Section) (Annual Meeting) (at Liverpool University), at 5 —A. H Amery Methods of Extracting Oil from Seed

North East Coast Institution of Engineers and Shipbuilders (at Mining Institute, Newcastle-upon Tyne), at 6.—A. Read Ships Electrical Deck Auxiliaries

Society of Chemical Industry (Birmingham and Midland Section) (Annual Meeting) (at Chamber of Commerce Birmingham), at 6.30 —At 7 —A. R. Warnes Some Little Known Causes of Stone Decay

Society of Chemical Industry (Manchester Section) (Annual General Meeting) (at Engineers Club, Manchester), at 7 —Major A. G Church The Attitude of the Government towards Scientific Research.

Institution of Electrical Engineers (Meter and Instrument Section), at 7.—Dr E H Rayner, W G Standring, R. Davis, and G W Bowdler Studies in Low Power Factor Measurements at High Voltages.

Institution of Mechanical Engineers (Informal Meeting), at 7 —A L Stanton and others Discussion on Smoke.

Royal Photographic Society of Great Britain (Pictorial Group), at 7 —Informal Meeting

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7 30.—W M Hurrell Visits to Iceland and other Places
GEOLOGISTS' ASSOCIATION (at University College), at 7 30 —A L Leach Geological Structure and British Coastal Scenery (Lecture) —A. L. Leach and A C Young On a Section in River Ravensbourne Valley Gravels at Lewisham.—A. L Leach Recent Excavations in the Shooters Hill Gravel

SATURDAY, APRIL 5

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (at Town Hall, Manchester), at 10 30 A M —D T Tansley Town Planning in the Manchester Regional Area —H. C Swindells Road Construction in Manchester
GILBERT WHITE FELLOWSHIP (Annual General Meeting) (at 6 Queen Square, W C 1), at 2 30 —At 3 —Sir Richard Gregory Primitive Astronomy (Lecture)
INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (at College of Technology, Manchester), at 4 —E J L. Howard and H Milner Some Aspects of Foundry Service to Engineers
MINING INSTITUTE OF SCOTLAND (at Glasgow) —Annual Meeting

MONDAY, APRIL 7

ROYAL SOCIETY OF ARTS (Dominions and Colonies Section), at 4 30 — Sir Edgar Jones The Empire Canning Industry
ROYAL INSTITUTION OF GREAT BRITAIN, at 5 —General Meeting
SOCIETY OF ENGINEERS (at Geological Society), at 6 —R. Borlase Matthews Rural Electrification and Electro Farming in Great Britain
ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8 —J H Worthington Antonio da San Gallo the Younger
ROYAL SOCIETY OF ARTS, at 8 —Comdr F G Cooper Aids to Navigation (Thomas Gray Lectures) (3)
SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8 —C Ainsworth Mitchell Circumstantial Evidence from Fibres and Hairs —J P O Callaghan Recent Advances in Water softening Practice
SURVEYORS INSTITUTION, at 8 —Prof T Wibberley The Future of British Agriculture
TWICKENHAM LITERARY AND SCIENTIFIC SOCIETY (at Free Library, Twickenham), at 8 —C Carus Wilson Coal
ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8 30 —Miss E J Lindgren North Western Manchuria and the Reindeer Tungus
TEXTILE INSTITUTE (London Section) (at Clothworkers Hall, E C) — W Kershaw Scientific Research as it affects Cotton Manufacture

TUESDAY, APRIL 8.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5 30 —N Matheson Some Features of Modern Steam Operated Deep Hole Rotary Drilling Plant.
INSTITUTION OF CIVIL ENGINEERS, at 6 —B B Haskew The Rebuilding of the Bassein Bridges on the Bombay, Baroda, and Central India Railway — W T Everall The Reconstruction of the Attock Bridge across the River Indus on the North Western Railway India.
INSTITUTE OF MARINE ENGINEERS, at 6.30 —S L Archbutt Recent Metallurgical Research in Relation to Marine Engineering.
INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (Annual General Meeting) (at Royal Technical College Glasgow) at 7 30.
QUEKETT MICROSCOPICAL CLUB, at 7 30 —Dr B F Barnes Induced Variation in Fungi.
EUGENICS SOCIETY (at Linnean Society), at 8 —Dr M Hamblin Smith, Judge R E Moore, and others Discussion on Delinquency
TELEVISION SOCIETY (in Botanical Theatre, University College), at 8 — Dr T H Harrison Photo Electric Cells and their Applications
ROYAL ANTHROPOLOGICAL INSTITUTE, at 8 30 —A D Hornblower The Elements of Egyptian Religion
ROYAL SOCIETY OF MEDICINE (Psychiatry Section) at 8 30 — Dr E Mapother and Dr A A W Petrie Impressions of American Psychiatry
ILLUMINATING ENGINEERING SOCIETY —S. Anderson Textile Lighting

WEDNESDAY, APRIL 9

GEOLOGICAL SOCIETY OF LONDON, at 5 30. — Dr L. W Collet The Structure of the Canadian Rockies
INSTITUTION OF CIVIL ENGINEERS (Informal Meeting), at 6 — S T Dutton Recent Developments in Railway Permanent Way Practice, with Particular Reference to the Use of Metal Sleepers.
INSTITUTE OF CHEMISTRY (London and South Eastern Counties Section), at 7 —Dr R M Brontë The Medical Witness
ROYAL SOCIETY OF ARTS, at 8 —Prof F A. E Crew Genetical Methods of Live Stock Improvement.

THURSDAY, APRIL 10

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Dr R H Crowley Parent Education, the Home and the School
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—S W Melsom, A N Arman, and W Bibby Surge Investigations on Overhead Line and Cable Systems.
INSTITUTE OF MARINE ENGINEERS (Junior Section), at 7 —Film Display The Manufacture and Operation of the Babcock and Wilcox Water tube Boiler, etc.
INSTITUTE OF METALS (Swansea Local Section) (at St. Thomas s Café, Swansea), at 7 —Annual General Meeting
INSTITUTE OF METALS (London Local Section) (Annual General Meeting) (at 83 Pall Mall), at 7 30.—Discussion on The Solidification of Metals
ROYAL SOCIETY OF MEDICINE (Neurology Section) (at Hospital for Epilepsy and Paralysis), at 8 30 —Clinical Meeting
BRITISH INSTITUTE OF RADIOLOGY, at 8 30.
ROYAL SOCIETY OF MEDICINE (Disease in Children Section).
OPTICAL SOCIETY (at Imperial College of Science and Technology).— Annual General Meeting
INSTITUTION OF WELDING ENGINEERS.—H. B White and R Tuddenham Some Interesting Arc Welded Jobs

FRIDAY, APRIL 11.

ROYAL ASTRONOMICAL SOCIETY, at 5 —R. O Redman The Galactic Rotation Effect in Late Type Stars
PHYSICAL SOCIETY (at Imperial College of Science), at 5 —Prof P Debye The Scattering of X Rays in Gases in Relation to Molecular Structure (Guthrie Lecture)
BRITISH INSTITUTE OF RADIOLOGY (Medical Meeting), at 5 —Discussion on Radiology in Bone Tumours.
MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6
INSTITUTION OF ELECTRICAL ENGINEERS (London Students Section), at 6 15 —Col Sir T F Purves Address
INSTITUTION OF CHEMICAL ENGINEERS (at Municipal College of Technology, Manchester) at 7 —Dr W H. Hatfield The Fabrication of Acid resisting Steel Plant (Lecture).
OIL AND COLOUR CHEMISTS ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7 —Annual Meeting
JUNIOR INSTITUTION OF ENGINEERS, at 7 30 —W T Dunn Gas in Japan and the Far East.
INSTITUTE OF METALS (Sheffield Local Section) (Annual General Meeting) (at Sheffield University), at 7 30 —F Russell Refractories and their Uses
SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Chemical Society) at 8 —Discussion on Asphalt as a Chemical Engineering Material —A W Attwooll The Principles of Manu facture of Mastic Asphalt —D McDonald Experience with Some Applications of Mastic Asphalt in a Chemical Works
ROYAL SOCIETY OF MEDICINE (Electro Therapeutics Section), at 8 30 — Dr H A Bulman Dr L H Clark, Dr S Russ, and Dr S Wright The Physiological Effects of Penetrating X Rays upon the Cat and Rabbit.
SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester) —Dr J L Hankey Some Remarks on the Treatment of Aniline Black subsequent to Ageing

SATURDAY, APRIL 12

PHYSIOLOGICAL SOCIETY (in Department of Physiology, University, Louvain), at 10 A M —G Debois Glycogen Recovery after Mammalian Muscular Activity as an Insulin Function —C Heymans and J J Bouckaert Sinus Caroticus Reflexes upon Venous Pressure, Liver Volume, and Heart Volume —P Rylandt Conduction in Mammalian Auricles —J Morelle Calcium Shifting Experimental Rickets — J P Bouckaert, J L Petit, and J de Blende Variations in Muscular Viscosity —J P Hoet and H Ernould On the Nervous Control of Insulin Secretion —P de Nayer Glycogen Deposition in Rabbits Muscles —L de Borggraef Ions and Excitability —E J Bigwood Chemical Properties of Gelatin Jellies — Thomas The Nature of Blood Sugar —T Lewis Reaction of the Human Skin to Cold — Prof A. V Hill The Osmotic Pressure of Muscles —Dr W Cramer On Inhibition of the Adrenal Gland and Vitamin B Deficiency —Dr J F Fulton Dr E G T Liddell, and D McI Rioch The Influence of Experimental Lesions of the Spinal Cord upon the Knee jerk and Crossed Extensor Reflexes —E W H Cruickshank An Adjustable Automatic Shaker for Gas Analysis.—*Demonstrations* —F Malengreau Micromethod for Estimation of Bismuth in Biological Material — J Rutten Isoelectric Point of Bence Jones Protein —J Morelle Calcium Shifting Experimental Rickets —J P Bouckaert Deter mination of Muscular Viscosity — A. K M Noyons Differential Calorimeter

PUBLIC LECTURES

TUESDAY, APRIL 8

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 4 — Sir Andrew Balfour The Life and Work of Dr William Henry Welch
GRESHAM COLLEGE, at 6 —Sir George Newman Physic. (Succeeding Lectures on April 9, 10, and 11)

ANNUAL MEETING

APRIL 9, 10, AND 11

INSTITUTION OF NAVAL ARCHITECTS (at Royal Society of Arts).

Wednesday, April 9 at 11 A M —Presentation of Institution Gold Medal to J Johnson and Premium to Lieut -Col F Dondona
Lord Wester Wemyss Presidential Address.
Sir Westcott S Abell and A. J Daniel Safety of Life at Sea (1929 Conference).
Eng Capt J Hope Harrison Some Materials used for Naval Engineering Purposes.

Thursday, April 10, at 10 30 A M —Dr W M Meijer Recent Results Obtained in Service with the High Pressure Steam Installation of the Holland America Liner *Statendam*.
W J Belsey Performance of Two Vessels with Electric Transmission Gear
At 2 30 —Col. F Modugno On the Final State of a Gas Discharged from a Reservoir into a Space under Constant Pressure
Dr B C. Laws Notes on the Behaviour of Two Passenger Vessels during a Voyage to and from Australia.
F H. Alexander Stability of a Vessel with a List.
Prof E G Coker and G P Coleman Stress Distributions in Notched Beams, and their Application

Friday, April 11, at 11 A.M —R Sulzer Causes and Prevention of Vibration in Motor Ships.
Dr J L Taylor Vibration of Ships.
Lieut. Col. F Dondona Sea Trials of Italian Flotilla Leaders.
At 3.—G S Baker and Miss E. M Keary Experiments on the Resistance and Form of Towed Barges.
W C S. Wigley Ship Wave Resistance—Some Further Comparisons of Mathematical Theory and Experiment Result

SATURDAY, APRIL 12, 1930

CONTENTS

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No 3154, Vol 125]

Experimental Work in Cotton Growing[1]

THE record of the valuable experimental work carried out under the ægis of the Empire Cotton Growing Corporation is brought down to the season 1928–1929 in the seventh volume of the series of reports The series possesses a double value It gives, as a continuous record, the progress of the experimental work in each country, from which it is possible to trace how one problem, by its solution, has led to another It also contains a record of the latest work in each country and should be of the greatest assistance to those faced with similar problems and difficulties elsewhere

The function of the stations from which reports are issued is to achieve practical results for the benefit of those growing cotton in the areas they represent To achieve those results it may be necessary to extend investigation by the inclusion of work of a more academic nature But by their practical results they will be judged It is pleasant, therefore, to note the considerable success achieved in this direction In the Jassid resistant *U4* cotton, South Africa has received a strain which can reasonably claim to have saved the situation, for, without it, cotton growing within the Union appeared to be doomed Pessimism is giving place to optimism, and, what is more, the success does not appear to be confined to the Union alone but it extends also to the two Rhodesias and Nyasaland In Fiji, too, the introduction of a Kidney cotton from New Guinea promises a definite benefit to the island in that its produce will no longer be confined to the narrow market for Sea Island cotton

The individual reports afford complete justification of these experiment stations by the indication given of appreciation of the practical results achieved In these are to be traced the influence of the particular economic conditions In South Africa it is the need for a Jassid resistant strain that has dominated the work , in Queensland it is cultural methods In the Sudan, matters are more complicated by the very diverse systems under which cotton is grown—systems which embrace the canalised area of the Gezira, the flood areas of Kassala and Tokar, all three of which are suited to Sakel, the pump irrigation systems of the Nile valley with their American strains, and the rains areas of the southern Sudan where American cotton is grown Here, perhaps, the need for meeting the pests, thrips, black arm, and now leaf curl, which

[1] Empire Cotton Growing Corporation Reports received from Experimental Stations, 1928–1929 Pp xi+268 (London) 2s 6d.

have successively attacked the crop, is predominant, and behind these lies the curious phenomenon of the suppression of fruiting branches, now interpreted as a conversion of sympodial into monopodial (vegetative) buds under the influence of abnormally high temperatures, which has given a physiological bias to the work. Despite these special demands, however, a broader attitude is being adopted towards the cotton crop, as is apparent from a perusal of the series of reports which have been issued. Increasing recognition is given to the fact that cotton cannot be treated in isolation and must be considered in its relation to other rotational crops. Rotations and fallows receive more detailed attention in the present than in earlier reports.

The reports issued by the Empire Cotton Growing Corporation give a sharp impression of the dominating influence played by insects in determining the success attendant on cotton growing, and of particular interest is the evidence from the Sudan, which indicates that leaf curl is a virus disease carried by a Jassid. So long as these conditions prevail, cultural problems must predominate. Until effective means of insect control are forthcoming, the problem takes the form of finding a plant sufficiently resistant to withstand the attacks, or of finding the conditions under which those attacks may be rendered least damaging, and any attempt to meet mill requirements and to apply recent knowledge as to the effective lint characters in producing a good spinning cotton must remain a secondary consideration. It is not surprising, therefore, that but little reference is to be found to this aspect, in which so vast a field remains to be explored.

The reports summarise a vast amount of work in many directions, and there arises a temptation to wonder whether the fullest use is being made of this mass of material. Cotton, in all its varieties, grows under a very wide range of conditions. In the majority of countries it matures on a falling temperature, and a limit to production may be imposed either by cold or by lack of humidity. But in the Sudan it matures on a rising temperature, while in Uganda, Fiji, and, to a lesser extent, in the West Indies, it is excessive humidity that predominatingly determines production. Thus the range of conditions covered by the various experiment stations is very wide.

The more fundamental problems underlying cotton growing may be approached in two ways. Detailed research in field and laboratory at a well equipped research station can do much. It is the intensive method. But the station must be localised and choice inevitably falls on that locality in which the plant is exposed to the minimum of risk, where, that is, limiting factors rarely come into play. Owing, however, to the variety of the conditions under which cotton is grown on a commercial basis, the question of limiting factors has an importance secondary only to that of pests; they may even be in large measure the cause of the severity of those diseases. With evidence that this is so the reports abound.

In these circumstances there is abundant scope for what may be called the extensive method of investigation—the comparison of different strains under the range of conditions available, so that they may be subject now to one limiting factor and now to another. Many strains are, it is true, at present so grown and must be subjected to a number of different limiting factors. But what steps are being taken to ensure that comparable records of growth are secured, together with comparable records of the various environmental conditions? And, if these steps are being taken, in what way are these records being co-ordinated and the results extracted? On these questions the reports are silent.

Folk-lore of the North American Indians

(1) *Tales of the North American Indians.* Selected and annotated by Prof. Stith Thompson. Pp. xxiii + 386. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1929.) 27*s*. net.

(2) *Prairie Smoke.* By Melvin R. Gilmore (Pahok). Pp. xiii + 208. (New York: Columbia University Press; London: Oxford University Press, 1929.) 12*s*. 6*d*. net.

A REPRESENTATIVE collection of the legends and traditional tales of the North American Indians might provide both a history and a textbook of the method of folk-lore. In no other part of the world have these stories been collected with greater assiduity and over a longer period of time, and in few, if any, do they cover a wider range of theme. Nearly three centuries have passed since the Jesuit fathers in 1633 first recorded tales current among the Indians with whom they had come into contact. To-day, the Bureau of American Ethnology, the American Museum of Natural History, the American Folklore Society, and the Anthropological Division of the Canadian Geological Survey are still engaged in the task of gathering up such remnants of this once great oral

literature as survive, with some vigour, among the remoter American peoples

In the relatively long period over which the work of collecting Indian tales has been spread, naturally there have been many changes in the attitude of the collectors towards their material and in their methods. They range from the sentimentalities of Schoolcraft and the conscious attempts at artistry of the early and middle nineteenth century to the severely scientific aim of the Bureau of Ethnology with its elaborately phoneticised text and literal and interlinear translations Somewhere, perhaps midway, between these come the contributions which educated Indians themselves have made to the record, varying a great deal in value, but often of noteworthy scientific import

During the last thirty or forty years the work of collection has proceeded apace, and on intensive lines varying to some extent, but not entirely, with the conditions of collection Thus Prof Boas has published a large number of texts received from the tribes of the north west coast and the Eskimo, the late Mr Hill Tout specialised in the legends of British Columbia, Dr Dorsey in the tales of the Plains Indians, James D Teit in those of the Thompson Indians, while F H Cushing made their mythology part of his intensive study of the Zuñi Indians These are a few only of the better known It is on the collections of these and others working on the same lines, rather than on original observation, that writers on Indian folk lore have relied when they have sought either to give a generalised view of the imaginative side of the Indian or have aimed at literary and artistic effect

(1) While Prof Stith Thompson aims at a comprehensive and representative collection of Indian legends and traditional tales, both in spirit and in method, he is strictly scientific Except for certain very slight modifications to meet the requirements of the general public, which will be obvious to everyone familiar with the Indian modes of presentation and phrasing, he has reprinted his stories in the words of the original translation, often happily preserving the style of the Indian narrator Not only are the stories representative of the various Indian tribal groupings, extending in the geographical sense from the polar north to Mexico, but also they are equally characteristic in the matter of theme Excepting in the first section of mythical stories, which follows a geographical order, the grouping of the tales is by theme Of these groups there are six—mythical incidents, trickster tales—a characteristic section which brings out the peculiar and somewhat cynical humour of these people—and hero tales, journeys to the other world, animal wives and husbands, and miscellaneous—a group which is not the least interesting It must not be thought, however, that the headings indicate the full scope of the interest of the tales to the student of folk lore *motif* An appendix of comparative notes reveals how rich American Indian folk lore is in this respect There are few of the *motifs* found in the legendary lore of other parts of the world which do not appear either incidentally or in chief in the tales of North America This appendix in itself, with its large number of references to Indian parallels, is alone a contribution to American folk lore studies of high value

Two very interesting questions are those of distribution and the closely related topic of the differentiation between the tales told in the various cultural areas into which American anthropologists divide the peoples of the continent Upon these points Prof Stith Thompson touches illuminatingly, if only briefly, in his introduction Many of the tales are common in their distribution, varying of course in their cultural background according as they are found among woodland, plains, pueblo Indians, and the rest But he goes on to show that in each group certain characteristic differentiations are to be observed Among the Eskimo, for example, the tales have a low level of interest, while the tales of the Plateau show a marked individuality, on the North Pacific coast there is a considerable variety, and, as might be expected from their totemic system, tales of animals, of whale and salmon, of ritual and social rank, are prominent, as well as tales of the other world In California the Indian seems to be interested only in the Creation and in the trickster

Two sections in addition to those already mentioned have a special interest for the student of modification in folk tales owing to contact Of these, one includes a number of tales derived from European sources, including Cinderella It may be mentioned in passing that in the south eastern States there is also evidence of negro influence The second group consists of tales drawn from Bible sources It is rather remarkable, in view of the widespread flood legend, that the story of the flood, as told here, is concerned entirely with the incident of Lot and his daughters, which is transferred to Noah

(2) "Prairie Smoke", more popular in form, may yet be taken as not unworthy of a place on the shelf with Prof Stith Thompson's more

elaborate work It deals with the Indians of the prairies, and while it consists in the main of their legends classified under sections to exhibit their modes of life and thought, it illustrates these with incidental descriptions of their culture and by references to events in their history

The Astrolabe

Early Science in Oxford Vol 5 *Chaucer and Messahalla on the Astrolabe* Now printed in full for the First Time with the Original Illustrations By R T Gunther Pp ix + 234 + 25 plates (Oxford Dr R T Gunther, Magdalen College, 1929) 42*s*

UNTIL the use of the quadrant became universal towards the latter half of the eighteenth century, the astrolabe was one of the most important scientific instruments at the disposal of astronomers and travellers It seems to have been invented in the time of the Greeks, and a number of elaborations made it in the medieval period not only an efficient observing instrument but also a portative set of astronomical tables It was of simple construction, not readily put out of order, and its graduation presented no great difficulties to skilled workmen There does not seem to be any reason, indeed, why it should not be reintroduced for making observations not requiring any high degree of accuracy

The astrolabe consists of a circular plate of metal from four inches upward in diameter In the portative forms a ring is attached for suspension from the finger A raised rim on the front makes a bed for a perforated plate called the 'net' On the back is a revolving bar with sights raised at each end The circle is graduated in degrees, days, and months concentrically, and there is in the middle a scale for measuring heights, etc On the front are concentric circles for the tropics and equinoctial line, a set of circular arcs giving altitudes, azimuth lines dividing the horizon into twenty four parts, and twelve similar arcs showing planetary hours The net lies over this, revolving freely, it marks the longitude and latitude of the principal fixed stars, and the zodiac The astrolabe was usually graduated for a particular latitude, but one form is adapted for use anywhere By it the altitude of the sun or a star, the time by day or night, the position of the moon, the height or depth of any point accessible or otherwise, and the hour of high tide, among other things, were found by simple observations

Chaucer's treatise on the astrolabe, written for the use of a child of ten, is a very satisfactory elementary text-book, provided that the pupil has the instrument in his hands, without this aid an understanding of the working requires attention Still, the disuse of astronomy as a foundation for astrology, and the alteration in our views on the solar system, have not altered the facts of the daily change in the aspect of the starry heavens, and if some simple form of the astrolabe could be brought into use in our schools, a standing blot on our educational system might be removed It is little short of lamentable that a boy may go through school and university without being able to point out any feature of the sky but the Plough and the Pole Star It is perhaps hopeless to expect any change from this in our town bred civilisation

The treatise was printed sixty years ago by Skeat for the Chaucer Society with a very full apparatus, including the text of the astronomical work which had been followed in its composition No better or fuller book on the subject has yet appeared The very handsome and well printed volume before us covers much the same ground as Skeat's edition, though with less help to the reader in the way of explanatory notes The title-page is a blot upon the book, a monumental piece of vandalism A page of a Chaucerian manuscript has been reproduced with the central portion of the text faded out to allow the insertion of the name of the work, of its editor, and of the claim that it is "now printed in full for the first time with the original illustrations"

This claim has only a modified justification The volume contains a modernised form of Chaucer's text, together with much of Skeat's text in the original spelling, some passages completing the subject from Chaucerian manuscripts (whether by Chaucer or no), and the "original illustrations" Of these, less than one-third are photographic reproductions from manuscripts of the astrolabe, the remainder are to all appearance photographed from modern copies of presumably medieval diagrams How far this justifies the editor's claim is a matter of opinion

The larger part of the volume is devoted to Messahalla, the author from whom Chaucer drew his information We are given the Latin text of his two treatises on the construction and on the use of the astrolabe together with a translation at once accurate and readable The texts were printed by Reisch in the sixteenth century and one of them by Skeat In addition to these the editor has given a facsimile of a Cambridge manuscript of the "De compositione astrolabii" There can be nothing but praise for this feature of the volume—every

important manuscript ought to be photographed at the earliest possible moment—but reproductions expose their editors to trying comparisons A single page of the MS (fo 62v) compared with the corresponding pages of expanded text reveals seven slips in copying The page was taken at random, and the slips were not important enough to affect the meaning

What is rather more important is that the editor should have neglected the opportunity of using his own powers of exposition to make the subject as clear as possible to the scientific reader At least he ought to have given us a series of photographs of an ordinary astrolabe bringing out its constituent parts, such as were published some years ago by the Indian Archæological Survey It is quite understandable that Dr Gunther should wish to include Chaucer's treatise in his collection of "Early Science in Oxford", but it then became incumbent on him to bring it home to modern readers R S

Kant's "Critique of Pure Reason".

Immanuel Kant's Critique of Pure Reason Translated by Prof Norman Kemp Smith Pp xiii + 681 (London Macmillan and Co, Ltd, 1929) 25s net

IT is astonishing how long the English speaking public has had to wait for an adequate translation of Kant's epoch making work The "Critique of Pure Reason" was published in 1781, all but a hundred and fifty years ago, and the first English translation did not see the light until 1838 The translator enlarges in his preface on the difficulty of rendering "so entirely novel and original a mode of philosophising", and almost disarms criticism by the modesty with which he acknowledges "how frequently, with every endeavour to be correct, he may have failed in a right understanding of his author" Meiklejohn, who next essayed the task, in 1855, produced a version which, in lack of a better, was destined to serve the needs of successive generations of students for three quarters of a century It is true that in 1881, the centenary of the original, a fresh translation was given to the public with an authoritative gesture by Max Müller This was certainly in point of accuracy and general effect distinctly better than Meiklejohn's, but by an unfortunate error of judgment the translation was made from Kant's first edition, whereas the second edition of 1787, in which Kant re-wrote important sections, must be regarded for ordinary purposes as the authoritative text of the work Unfortunately, too, the translation, at least as originally issued, was encumbered, by way of introduction, with a crudely written historical sketch of all previous philosophy by Prof L Noiré, extending to no less than 360 pages For its irrelevance and lack of all proper perspective, this so-called introduction was drastically characterised at the time by the late Prof Adamson as "comprehended under the well known definition of dirt matter in the wrong place" Under these disadvantages it was no wonder that the centenary translation failed to 'catch on', and Meiklejohn continued to be the ordinary student's vade mecum up to the present day This was perhaps scarcely to be regretted, for, although of course absolutely competent in his knowledge of German idiom and his mastery of the English language, Prof Max Muller was, after all, not a professional philosopher, and Adamson in his careful and appreciative review of the book for *Mind* felt "constrained to add that the ideal translation does not yet seem to have been attained" After giving examples of his meaning, he concludes in fact that the translation "stands in need of a thorough revision from the philosophical point of view"

The ideal is, I suppose, under human conditions never fully realised, but I think Prof Kemp Smith's translation must at least come very near to satisfying Adamson's exacting demands Prof Kemp Smith is in the best sense of the word a philosopher by profession, and moreover he has devoted the maturity of his powers to an exhaustive study of the Kantian philosophy and more particularly of the "Critique of Pure Reason" His "Commentary" on that work was recognised at once on its appearance, in 1918, as raising the study of Kant in Great Britain to a higher level There is room, of course, for difference of opinion in regard to certain of his conclusions, but his firm grasp of the whole subject was everywhere apparent, especially in the use he made of his extensive literature which has grown up round the "Critique" in Germany since 1880 A better preparation for the work of translation can scarcely be imagined, and students of philosophy may congratulate themselves that he has found leisure to carry through what must have been of necessity a laborious and often an irksome task For, as he truly says at the outset of his "Commentary", "the 'Critique of Pure Reason' is more obscure and difficult than even a metaphysical treatise has any right to be" In his other works Kant often writes as clearly and forcibly as anyone could wish, but

in this "Critique" there can be no doubt that many of the difficulties which embarrass a translator (and as Prof Kemp Smith says, "multiply rather than diminish upon detailed study) are due to the circumstances in which the work was originally published" Kant has told us himself how he pondered the subject for at least twelve years, whereas the book itself was hurriedly "brought to completion" within four or five months, in the fear lest, if further delayed, it might never see the light at all This was for long taken to mean that the whole work was written during these four or five months of 1780 But much light has been thrown more recently upon Kant's habits of working by the publication of "Reflexionen" and "Lose Blätter" found among his papers, and it is practically certain that Kant must have possessed similar drafts of portions of the "Critique", written at different times during the twelve years of incubation These he would naturally use to piece out his argument, without noticing possible inconsistencies in detail with the positions in which he had finally come to rest Patient criticism has indeed succeeded in establishing that the "Critique" is to that extent a composite work, different parts of which belong to different stages in the development of Kant's views

The present translation follows the text of the second edition, but gives at the foot of the page all the passages from the first edition which have been omitted or altered in the second The pagination of the two editions is also given in the margin as A and B Where emendations of the German text have been suggested by successive editors, Prof Kemp Smith gives in a footnote the reading which he follows, and wherever there might be a doubt as to the precise meaning of an English word or phrase in the translation he has similarly added in a note the German equivalent This critical apparatus is welcome, and was indeed essential in the present edition, but for the ordinary student, not conversant with German and intent only on a trustworthy translation, it is in a sense a luxury As Prof Kemp Smith's version must now rank as the definitive and authoritative English translation, it is to be hoped that the publishers may soon see their way to issue an edition of the text alone at a more popular price In such a text book it would be desirable to make the translation of the second edition read continuously and to relegate the variations of the first edition, including the two long sections re written by Kant, to an appendix

A S PRINGLE-PATTISON

Our Bookshelf.

Die Salzkäfer der Nord- und Ostseeküste mit Berücksichtigung der angrenzenden Meere sowie des Mittelmeeres, des Schwarzen und des Kaspischen Meeres, eine ökologisch biologisch-geographische Studie Von Hanns von Lengerken Pp iv + 162 (Leipzig Akademische Verlagsgesellschaft m b H, 1929) 8 75 gold marks

THIS is a very useful account of the beetles which inhabit the salt water coastal regions of the North Sea and Baltic The author divides them into three groups which he calls 'Haloxenen', 'Halophilen', and Halobionten' The first is omitted as the beetles are only brought into the salty region by outside agencies, such as winds and storms, the second includes those species which are not dependent on salt but are chiefly found in salty situations, the third are truly dependent on salt and never found elsewhere

At present, however, there seems to be nothing positive known as to the influence of salt on the beetles The only truly marine species in the region is *Macroplea mutica*, although such brackish water forms as the *Ochthebius* species may also be admitted By far the most of the salt water Coleoptera come under the heading 'Coastal beetles', and there are a large number of these belonging to 63 genera and 17 families A detailed study of distribution is given, and, for the purposes of comparison, neighbouring coasts other than the North Sea and Baltic are reviewed as well as the Mediterranean, the Black Sea, and the Caspian Sea

This ecological, biological, and geographical study is of great value and the notes on the various species are extremely interesting, for, besides morphology, habitat, and food, the life histories are included whenever possible Much of this is the author's own work, and one reads with pleasure his detailed accounts of *Cicindela hybrida marina* living on fine sand and in sandy burrows, and *Hæmonia (Macroplea) mutica* which is in all stages peculiarly adapted for breathing under water So delightful and lifelike are the pictures of *Cicindela* that one wishes there were more figures in the book One also misses a detailed index, only a table of contents going as far as the genera being given There is a good bibliography, most of which is divided geographically

The Economic Life of the Ancient World By Jules Toutain Translated by M R Dobie (The History of Civilization Series) Pp xxvii + 361 (London Kegan Paul and Co, Ltd, New York Alfred A Knopf, 1930) 16s net

THE 'Ancient World' with which M Toutain deals is that of the Mediterranean area, or rather of Greece and Rome with other countries considered only as subsidiary to these He begins his story with the Greece of Homer and Hesiod and traces its economic development down to the end of the Hellenistic period He then turns to Rome and the western Mediterranean, but before dealing with Italy and Rome's historic rival Carthage, to pro-

vide a background for the picture, he analyses the economic activities of prehistoric man Thence the economic system of Rome is traced until it reaches its culmination under the Antonines and finally breaks up before the inroads of the barbarians

M Toutain's subject is one of some difficulty, for outside certain aspects which were the problems of ancient society, such as the agrarian question at Rome, direct evidence is scanty The author shows little inclination towards generalisation and theory He prefers matters of fact and deduction from historical evidence in the stricter sense Sound as this method may be, it has its obvious limitations When, for example, he deals with the question of land tenure in early Greece, he holds that the whole of the evidence is to be interpreted in favour of individual tenure or, doubtfully at most, tenure on behalf of the *genos* or family group In his opinion, geographical conditions imposed this organisation inevitably on Greece, and the communal tenure of land of primitive man, or even of such social groups as those of Russia, he holds, is not analogous But the literary evidence at best is ambiguous or indecisive, and it would be legitimate to interpret it in the light of what is known of the social system of the invaders from the north in their own land M H Baer in his introduction provides the generalisations on ancient economics from which the author has refrained, but even without these, the book will be for the student a convenient and valuable compendium of the economic and social facts

Introduction to Theoretical Physics By Prof Arthur Haas Translated by Dr T Verschoyle Vol 2 Second edition Pp xi + 492 (London Constable and Co, Ltd, 1929) 21*s* net

THE second edition of Vol 2 of Prof Haas's "Introduction to Theoretical Physics" deserves special mention, because in the four years which have elapsed since the publication of the first English edition (NATURE, vol 117, p 687) great strides have been made in the development of atomic theory The changes in outlook consequent on the introduction of the wave theory of matter and of the new quantum mechanics are reflected in Part III, which has been almost entirely rewritten It is significant of the new point of view that the chapter on the principles of atomic mechanics begins with a description of de Broglie's theory, which is followed by an account of Schrödinger's theory It is not until the following chapter that we meet with a detailed statement as to atomic spectra, and the explanation of the spectrum of hydrogen by means of Bohr's model Prof Haas has written a separate volume on "Wave Mechanics and the New Quantum Theory", in which these subjects are treated at greater length, but it is convenient to have such a concise and clear account of the new developments as that given in the book here noticed

In Part IV, which deals with the theory of heat, several new sections have been supplied, and we have noticed several minor additions to the text which make for completeness There is no doubt that in its revised form the work will meet the needs of many students of physics, and it deserves success H S ALLEN

Greenland (Published by the Commission for the Direction of the Geological and Geographical Investigations in Greenland) Editors Prof M Vahl, Vice Admiral G C Amdrup, Dr L Bobé, Prof Ad S Jensen Vol 3 *The Colonization of Greenland and its History until 1929* Pp v + 468 (Copenhagen C A Reitzel, London Oxford University Press, 1929) 35*s* net

WITH this volume the great work on Greenland, which embodies all available knowledge of the island, is completed An introductory chapter on types of European colonisation is an excellent geographical introduction to a detailed study of the colonisation and trade of Greenland and the economic and social condition of the Greenlanders Little of this matter has been previously accessible in English

Other chapters deal with the status of Greenland in international law and the sanitation and health conditions Admiral Garde discusses the navigation of Greenland waters and gives some indication of the old Norse routes So far as can be judged from scanty directions, the old Norse ships followed courses that are suitable to day, and they afford no evidence of material changes in ice conditions Prof Bøggild adds a short chapter on mining, which relates chiefly to cryolite The volume concludes with an etymological glossary of Eskimo place names, and an index to the folded map of Greenland on a scale of 1 4,000,000 is combined with the index to the three volumes

The British Hydracarina By Chas D Soar and W Williamson Vol 3 (Ray Society Volume No 115, for the Year 1928) Pp viii + 184 + plates 41 60 (London Dulau and Co, Ltd, 1929) 37*s* 6*d*

WE welcome the appearance of Vol 3 of Messrs C D Soar and W Williamson's monograph published by the Ray Society on the British Hydracarina It treats of the remaining species of the subfamily Pioninæ, together with the Aturinæ, Mideopsinæ, and Arrhenurinæ, and at the end of the book there is an index to the genera and species dealt with in the complete three volume series. It is well up to the high standard attained by the Ray Society publications and is profusely illustrated by nineteen plates, of which the first six are coloured Each species is separately figured and there are many illustrations of detailed characters A work of this description which provides a ready means for identification is always a stimulus to the further study of the group concerned, and we trust that it will result in this section of the British mites becoming much better known Workers in the group are very few and far between, and there is a wide scope for the collector to extend our knowledge of the distribution of many of the species and to bring new forms to light

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

School Science and Educational Values

I HAVE no word but of thanks to A A E for his kindly comments in NATURE of Mar 8 upon my articles in the *Kentish Mercury*, yet I cannot but take up the challenge he gives in saying that it can scarcely be supposed that I am attempting to deny the appropriateness of an independent test in helping to determine how a pupil is reacting towards his educational environment Big words these! To me, it seems that there is little *educo* about the business and far too much environment that it is a case of crowding quarts into pints you just test how far the poor little beggar examined happens to be inflated at the moment

I am not clear whether my critic question my denial of the *appropriateness* of any external examination test that may be applied or my objection to *any independent test* I object to both, as physically, mentally and morally harmful to all concerned, to teachers and taught, to parents and examiners The system is of quite recent growth in Great Britain, a modern industry, in fact The men who have made the British Empire have not suffered under it, nor have most of the leaders of to day As the gift of leadership is going from us, we cannot claim that we are now gaining from it Scots have been trained to be efficient, in days gone by, in the smallest country villages, without external interference To day they are officially, hopelessly over examined and by no means so dangerous to the south as they were—the more as they no longer eat oatmeal It is sad that a great people should lose intelligence and individuality through an ill chosen educational test and an attenuated diet The public schools, to save themselves trouble, have adopted a common entrance examination—the result is that the preparatory schools are obliged all to tar with one brush That the product lacks character to day is in no way surprising We do our best to eliminate the quality we most need individuality and strength of character It is a disaster that we no longer trust teachers

The great pioneer of the heuristic method, Mr Squeers, we may be sure, not only taught his boys how to spell 'winders' practically but also himself examined into their being well and truly cleaned he doubtless was careful to drive the whole lesson home his chronicler make no mention of any external examiner The two colleges with which I have been connected, the Finsbury Technical College and the Central at South Kensington, long flourished without external examinations, using material—in my day—which was neither 'matriculated' nor 'school certificated' The Central product had courage, went out into the world and did well to day, I am told, it will not venture abroad

Our bondage comes in large measure from the anti heuristic, unpractical University of London and the wicked example it has set—by opening the matriculation to others than those who were proceeding to its degrees The University of London has lived upon matriculation fees—these are the main support of the large and ever growing army of bureaucratic officials The School Certificate examination is now a most dangerous option to the London Matriculation, as boys may pass it when under fifteen and then specialise

Most unfortunately, the fact is, man cannot let man alone he ever tends mercilessly to oppress the child he never recognises his own great individual ignorance and inability to guide himself, let alone others, through the maze of life He thinks in his own superior terms of disciplined ignorance all the time, not in those of the child's quenchless thirst and desire to develop intelligence

In our gardens, when plants begin to show signs of healthy growth, we do not take them up to examine their roots We regard them lovingly, knowing that if we wish them to flourish we do well to let them alone and merely take care that their surroundings be kept normal and healthy in due course they flower and fruit—we test the fruit by eating it, not by examination The bad is obviously bad Teachers, if and when competent, know full well how far their pupils—to use terms of the phrase rule—are reacting towards their environment Examination tests are advocated, to day, because they give employment to testers I have been eye witness of the insidious rise of the whole system Fortunately, my children have escaped from it but I am obliged to see my grand children suffer

The continued failure of the schools and universities to make proper use of the vast fund of knowledge and experience now available—to be scientific—is by far the blackest sign to day of our inability to avail ourselves of the gift of intelligence the Gods would give us All we can do is to extend the use of machinery and create more and more unemployment soon, we shall examine for this and make the occupation competitive Our own marvellous mechanism is in no way used intelligently We allow those, the merely literary, who have no experimental sense, to govern HENRY E ARMSTRONG

UNFORTUNATELY, I find some difficulty in following Prof Armstrong's argument He complains both that teachers are incompetent and that we do not trust them, both that we fail to apply scientific method to education and that we use similar standards to measure the results of similar experiments by different experimenters Were Prof Armstrong to confine himself to urging far more intimate contact and closer co operation between teachers and examiners (usually themselves teachers) he would, I think, serve the interests of the examined, while preserving our admittedly approximate, but only, method of differentiating degrees of ability Whether or no all independent tests are universally harmful, whether or no examining bodies levy an unjust tax on students, whether or no there is still time to promote fruitfulness when the fruit is ripe, Prof Armstrong provokes us to consider such questions anew Let us apply to them our "vast fund of knowledge and experience", even although he finds that we are ignorant, and that we are unintelligent, a conclusion which the best informed and most sagacious of us will be the last to deny A A E

The Homogeneous Isothermal Reaction $2CO + O_2 = 2CO_2$ in the Presence of Water Vapour

DURING the past two years I have studied the oxidation of carbon monoxide, in silica bulbs, by a manometric method A satisfactory interpretation of the complicated reaction kinetics has not yet been found, but it may be permissible to state in outline the results obtained, since the reaction is of general interest

(1) In a mixture of $CO + O_2 + H_2O$ (0 13 per cent upwards) at total pressures from about 70 mm. upwards,

a homogeneous reaction can be measured in clear silica bulbs, between 530° and 730° C

(2) The presence of water vapour appears to be essential for this reaction there is approximate proportionality between water concentration and velocity for example, at 580°, with excess of carbon monoxide

pH_2O	1 8	6 2	9 0	1[illegible]	mm
velocity	5 3	18 7	25	49	per cent per minute

Using oxygen and carbon monoxide which had stood over phosphorus pentoxide for one day only, the rate was 0 2 per cent per minute at 600° C, while with a mixture which had been standing for several weeks over phosphorus pentoxide the rate first became measurable at about 700° C

(3) The rate (with concentration of water molecules constant) is roughly proportional to concentration of carbon monoxide molecules when oxygen is in excess, and proportional to a power of the concentration of oxygen molecules approximating to zero, when carbon monoxide is in excess, for a given total concentration

(4) The reaction has a chain mechanism, with 'stable' chains at pressures exceeding a certain limit The evidence for this is the increase in temperature coefficient as the temperature rises, and the retardation in a 'packed' bulb with a surface volume ratio increased 18 5 fold

H Kuhl (*Zeit phys Chem*, 44, 385, 1903) studied the oxidation of carbon monoxide in porcelain bulbs, and attributed the irregularity of the results to catalysis by the walls The present results in silica bulbs are rather more reproducible, but it is now clear that the reaction measured by Kuhl must also have been a chain reaction in the gas phase, because of the general similarity of the two sets of results In particular, the rate in comparable reacting mixtures is about the same at the temperature at which Kuhl worked (575° C)

It should be mentioned that the reaction has also been studied by Prof Bodenstein (Bodenstein and Ohlmer, *Zeit phys Chem*, 53, 166, 1905) in silica bulbs, with results completely different from my own Rapid combination was observed at temperatures so low as 318° 230° C It seems most probable (as suggested by Benton and Williams, *Jour Phys Chem*, 30, 1487, 1926) that the reaction was caused by traces of impurity on the walls—a possibility suspected by the authors themselves, in some of their experiments

(5) When a sudden addition is made of oxygen, carbon monoxide, or carbon dioxide to a mixture reacting at a steady rate in the region of the stable chain mechanism, the reaction is retarded in each case, provided that the concentration of water molecules is kept constant If, on the other hand, the *total concentration* of such a reacting mixture is progressively decreased by removal of gas from the bulb, the absolute reaction rate at first decreases, passes through a minimum, and then increases again rapidly, until at a definite concentration inflammation sets in A typical example is that at 570° a $2CO + O_2$ mixture + 2 5 per cent H_2O decreases in rate of combination from 500 mm to a minimum at about 90 mm, and increases again rapidly to a critical pressure of 65 mm, at which the mixture explodes

(6) The reaction in the stable chain region is accompanied by a violet glow I am indebted to Mr. A L Carrad for the following observation the glow, observed in a wide quartz tube with a quartz window, at 570° C, becomes more intense as the reacting gas is pumped out of the tube, until near the critical pressure a rapid increase in brightness culminates in a vivid flash. Thus the inflammation at this (upper) critical pressure completes a region of increasing velocity, and may therefore be a case of thermal acceleration following upon the increase in velocity which arises in the first place from diminished deactivation of reaction chains in the gas phases

In a recent paper Prof Semenoff and co workers (*Zeit phys Chem*, B, 6, 307, 1930) have investigated carefully the upper and lower pressure limits for inflammation of $CO + O_2$ mixtures expanded from a mixture originally saturated with water vapour So far as my own observations go (made upon the upper limit only), the results agree with those already published by Prof Semenoff, in addition, I find that both the existence of the critical limit for inflammation and the behaviour of the 'slow' homogeneous reaction described in paragraphs (5) and (6) are dependent upon the presence of a sufficient proportion of water vapour, otherwise the reaction rate decreases continuously as the total concentration is reduced, and there is no minimum and no inflammation

It has been shown by Prof Garner ("The Initiation of Flame in Mixtures of Carbon Monoxide and Oxygen", Garner and Gomm *Trans Farad Soc*, 24, 470, 1928) that the *lower* pressure limit for inflammation (5 10 mm total pressure, from 660° to 850° C) is the same whether the original mixture is dried by passage over 10 cm of phosphorus pentoxide, or is saturated with water vapour This is interesting and unexpected in view of the dependence of the *upper* pressure limit and the 'slow' homogeneous reaction upon water vapour concentration

(7) I have once or twice encountered an induction period prior to explosion, under conditions similar to those of the following instance 258 mm carbon monoxide, roughly dried by phosphorus pentoxide, added to 118 mm oxygen similarly dried, remained quiescent for 2 minutes and then exploded

A point which I hope to decide by further experiment upon this phenomenon and the general kinetics of the 'slow' homogeneous reaction is whether the initiation of the reaction chains involves the silica surface, through the catalytic effect upon the water gas reaction, with H_2, and H_2O_2 or OH as links in the chain

B TOPLEY
University College,
London, Feb 18

Group Velocity and Wave Mechanics

IF it be true that Nature is built up not of particles but of waves, it is obviously of great importance to gain clear ideas as to the characteristics of wave motion In dealing with any oscillatory motion, Dr Albert Campbell suggested several years ago the use of the term *pulsatance* (an alternative form some times used is *pulsance*) for $2\pi\nu$ where ν is the frequency (*Proc Phys Soc*, vol 31, p 80, 1919) Thus the pulsatance is the number of vibrations in 2π units of time I have found this term of very great service in teaching, as it economises time in discussion and space in writing or printing Even the elementary student appreciates its value when he recognises that it corresponds to angular velocity in the reference circle in defining simple harmonic motion Such a motion is represented by the equation $y = A \sin pt$, where A is the amplitude and p the pulsatance

Similarly, in discussing wave motion, it is convenient to introduce a quantity expressing the number of waves, each of wave-length λ, in 2π units of length I propose, tentatively, to call this quantity $k = 2\pi/\lambda$, the *undulatance* The equation for the simplest type of wave motion, the progressive harmonic wave, is now $y = A \sin (pt - kx + \epsilon)$ The phase of the wave motion is determined by $\phi = pt - kx + \epsilon$, and the phase velocity, $u = p/k$, is obtained by dividing

the pulsatance by the undulatance This follows from the fact that if we substitute $t+t'$ for t, and $x+\frac{p}{k}t'$ for x, the equation is unchanged in form

The discussion of group velocity (see, for example, Sommerfeld, "Wellenmechanischer Ergänzungsband", or Haas, "Wave Mechanics", Chap ii) may now be abbreviated as follows When there is approximate agreement of phase among the waves belonging to a group, the resultant vibration is relatively large The 'centre of energy' of the wave group is characterised by the fact that the partial differential coefficient of the phase with respect to the pulsatance must vanish, or $\partial\phi/\partial p=0$ This condition results in the equation $x=\frac{dp}{dk}\left(t+\frac{d\epsilon}{dp}\right)$, showing that the centre of energy moves with a velocity g, the group velocity, given by $g=dp/dk$ (Rayleigh, "Theory of Sound", vol 2, p 297) This leads quite simply to the more familiar expressions for the group velocity in terms of frequency (de Broglie) or wave length

Assuming that a mass particle, m, moving with velocity v is associated with a system of waves, it can be shown by employing Einstein's principle that the phase velocity $u=p/k=c^2/v$, and is accordingly greater than c, the velocity of light The pulsatance p is related to the pulsatance p_0 referred to a system of co ordinates moving with the body by the Lorentz equation $p=p_0(1-v^2/c^2)^{-\frac{1}{2}}$, so that $p^2(1-v^2/c^2)=p_0^2$, or $p^2-c^2k^2=p_0^2$ From this we find $g=dp/dk=c^2k/p=v$, and so we see that v the particle velocity is the same as the group velocity g

It will be seen that this derivation of the result is shorter and more direct than that usually given, although there is nothing essentially new in the method The phraseology here suggested will be found useful in dealing with the wave mechanics of Louis de Broglie and of Schrödinger

In this connexion it may be pointed out that it would be a great convenience in theoretical work to have a recognised symbol to represent $h/2\pi$, the quantum unit of angular momentum A small letter, not a capital, is desirable, and after considering various possibilities, it is suggested that the letter b may be suitable We should then write $b=h/2\pi$ and the fine structure constant would be given by $\alpha=e^2/bc$ According to Eddington's recent calculation $bc/e^2=137$ The letter b may serve to recall the name of Niels Bohr, although it should be remembered that J W Nicholson was the first to employ the quantity $h/2\pi$ in his work on the spectra of nebulæ and the solar corona (1911–12)

H S ALLEN
The University,
St Andrews, Mar 22

The Acquired Characters of *Alytes*

THE reading again, after many years, of von Nägeli's account of his experiments with Alpine plants[1] has suggested to me the possibility that Kammerer's experiments with *Alytes* may have no bearing upon the inheritance of acquired characters, even if we accept all the results he claimed, and all that others have claimed on his behalf

May I give a very brief sketch of von Nägeli's experiments? He took some Alpine plants from their ordinary surroundings and placed them in rich soil, under the usual conditions of cultivation, in the Botanical Gardens at Munich The plants thus removed from their normal environment changed in their characters so much that, had he not seen the transformation taking place, von Nägeli would not have recognised them The seeds of these plants grown in the Botanical Gardens under the same conditions, reproduced the characters that their parents had developed under cultivation, and this went on for about thirteen years But when, at the end of this period, some of the plants were removed to poor and stoney soil, they reverted to the characters of their Alpine ancestors, which characters had not appeared for all these generations Moreover, the seeds of the plants in the Botanical Gardens when grown under Alpine conditions produced the characters of their comparatively remote ancestors and not those of their parents for thirteen generations back

A comparison of this with what happened in Kammerer's *Alytes* is, I think, very illuminating *Alytes* and its young pair, hatch out and live on land, and, though the embryo has a gill, it loses this before coming out of the egg The male *Alytes* does not develop the nuptial pad present in other toads and in frogs, such a pad would be useless to it When, however, *Alytes* was kept warm and given free access to water in sufficient quantity, a change in several of its characters was produced Pairing took place in the water, and the eggs, after fertilisation, instead of being carried about by the male, were deposited as are those of other allied species and genera The larvæ from these eggs, hatched out in the water, had gills The males, it is stated, developed nuptial pads similar to those of other male toads and frogs, though these pads were imperfect, and this continued in succeeding generations

But—and this is to me the crucial point—all the subsequent generations were given free access to water Indeed, had they not been able to breed in the water, several of these changes of character must have proved fatal to the offspring

The question is whether, had these subsequent generations of *Alytes* been deprived of access to water, they would not have reverted to the characters of their ancestors, including the disappearance of the nuptial pads? I gather that nothing of this kind has been tried, and until it is, these new characters appear to me to mean no more than did the new characters of von Nägeli's Alpine plants What happened in both cases may be explained most simply by the presence in the germ plasm of potentialities to respond in a definite manner to changes in the environment, and to me the simplest explanation appears most likely to be true Any other would require quite unnecessary assumptions

Until, therefore, some enterprising biologist who has the facilities, completes the experiment as I have suggested, the question must remain open My personal belief is that the answer will be that *Alytes* will behave much as did the Alpine plants It would be too much to expect that the two cases would be parallel in detail, but I suggest that the general result will be the same

CHARLES WALKER
The University of Liverpool,
Mar 14

[1] C von Nägeli "Mechanisch physiologische Theorie der Abstammungslehre Münich and Leipzig, 1884

A Singular Behaviour of Striæ in the Positive Column of an Electrical Discharge through Hydrogen

THE following behaviour of some striæ in the positive column of an electrical discharge through rarefied hydrogen seems to be of sufficient interest to warrant a description The distances between adjacent striæ in hydrogen change with gas pressure in an anomalous manner first noted by Willows (*Proc Camb Phil Soc.*, **10**, 302, 1900), in that, with reduction of pressure,

they at first increase in magnitude, pass through a maximum value and then in turn through a minimum value. This minimum occurred at about 1·5 mm. pressure in the discharge tubes I used, which had an internal diameter of 11 mm. The striæ here were bluish in colour, whereas at the other pressures their colour was reddish. The phenomenon to be described was only observed in this narrow pressure region where the striæ were most closely packed. The discharge current was kept constant at 6 milliamperes and it passed between cold electrodes consisting of aluminium cylinders 2 mm. in diameter.

When the critical pressure was reached, a very slight reduction of pressure caused the stria nearest the cathode to leave the positive column and move slowly across the whole Faraday dark space up to and beyond the end of the cathode. Here it remained as a distinct band of light encircling the cylindrical cathode. During all this time the remainder of the positive column remained unchanged in position. A further reduction of pressure caused a second stria to detach itself from the positive column and in turn to proceed slowly up to the cathode and to merge there with the first stria. A still further reduction of pressure often made a third stria repeat the performance of the first two. When the pressure was now very slowly increased the reverse process took place, one of the striæ detached itself from the band of light around the cathode containing the merged striæ and marched slowly back until it resumed its original place in the positive column. Then in its turn the second stria, and finally the third, did the same thing. The whole procedure could be repeated at will.

No explanation of this curious behaviour of these striæ has been found. It is known that the electric field throughout the Faraday dark space is very small compared to the average field prevailing in the positive column. The existence of this dark space seems to be dependent upon a copious supply of electrons coming from the negative glow as well as upon electric charges on the walls of the discharge tube. The Faraday dark space is thought of as a unit, the cause for the existence of which proceeds from the cathode. How, then, is it possible to divide this region of low field intensity into two parts by the intrusion of a stria with its presumably much larger fields? In other words, when the Faraday dark space has once terminated at the isolated stria, what brings it into existence again beyond this stria? It would appear that conditions at the surface of the walls of the tube play a large rôle in the phenomenon described, and that these conditions are markedly affected by a slight change of pressure at the critical value here involved.

Other observers have remarked upon the fact that at a certain pressure the discharge through hydrogen undergoes a sudden change during which a number of the striæ from the end of the positive column jump to the cathode. The observations noted above show that the change is not a discontinuous one, but that during a very slow reduction of pressure the whole process may be followed continuously in detail.

JOHN ZELENY.

Sloane Physics Laboratory,
Yale University, Feb. 26.

Mounting Media for Microscopic Work

IN the examination of colourless transparent objects under the microscope, it is important to have sufficient difference of refractive index between the objects and the mountant to retain visibility of outline under critical conditions of illumination. In addition to this, it is essential that there shall be no effect on the structure of the preparation, such as the swelling produced in some dehydrated materials by aqueous mountants. To fulfil these conditions I prepared a new medium with a cellulose ester base, the refractive index of which could be varied within quite wide limits (n = 1·45 to 1·57) by the addition of a plasticiser of suitable refractive index and a volatile solvent to dissolve the mixture.

A medium giving a refractive index of 1·42 when liquid, rising to 1·47 when hard, which is very useful for unstained cellulose materials (n – 1·52 to 1·54), has the following percentage composition:

Cellulose nitrate (extra low viscosity type—Nobel's H X 2)	25
Triacetin	25
Methyl ethyl ketone	50

Mixed together and stirred until dissolved.

The medium is applied in the same manner as Canada balsam and allowed to harden either with or without heat. During the hardening process the ketone evaporates and the refractive index rises from the lower to the upper value.

The refractive index data of other media in which various plasticisers have been substituted for triacetin, but without any other change, are given below, together with comparative values for euparal and Canada balsam resins. It will be seen from the table that these new media give a considerably extended range, from which in most cases a suitable one may be chosen, though there are naturally many others available.

Mountant	Refractive Index	
	Liquid	Hardened
Cellulose nitrate, methyl ethyl ketone and		
Triacetin	1·417	1·471
Resorcinol diacetate	1·435	1·517
Benzyl alcohol	1·442	1·525
Tricresyl phosphate	1·448	1·545
Benzophenone	1·461	1·573
Euparal	1·481	1·525
Canada balsam (Xylol)	1·530	1·545

Cellulose acetate can be used in place of cellulose nitrate and is found to give somewhat lower values of the refractive index with the same plasticiser. However, in the case of the acetate, more dilute solutions must be used in order to obtain a sufficiently fluid medium.

J. M. PRESTON.

The Dyehouse,
College of Technology,
Manchester, Mar. 15.

THE mountant suggested by Mr. Edwin E. Jelley in NATURE of Feb. 22 raises some points of interest. Visibility of uncoloured microscopical objects is dependent on a difference in refractive index between the object, or any part of it, and its environment, usually a mountant. The principles involved were expounded for petrological specimens by Mr. Sorby and for diatoms by Mr. Stephenson fifty years ago.

Many mountants have been tried for diatoms, and I. D. Möller especially mounted some of his type slides in mono brom naphthalene. One, belonging to the Geological Department of this University, now shows minute globules, probably aqueous, on the under surface of the cover glass. Theoretically there appears to be little advantage in Mr. Jelley's mountant for diatoms and crystals. If a slide with such a mountant is not rung with a suitable protective, evaporation of the mono brom-naphthalene will slowly occur and

eventually the mountant will be simple Canada balsam If the slide is to be rung, it would generally be better to mount in the brom naphthalene alone and thus obtain the advantage of a higher refractive index Should, however, such a mixture be required, styrax, which is also soluble in mono-brom naphthalene and has a higher refractive index than Canada balsam, would generally be a preferable ingredient A workable combination has a refractive index of 1 62

In October of last year I carried out an investigation on the influence of the refractive index of mountants on biological tissues which I hope shortly to publish Tissues were mounted in media of varying refractive index from 1 34 to 2 1 (phosphorus) The mountant of highest refractive index that could be conveniently used was a saturated solution of sulphur and arsenious sulphide in methylene iodide Such a mixture is of a canary yellow colour and has a refractive index of 1 804 It is apparently stable, since it has been kept in an open test tube, apparently unchanged, for five months Mounts in this liquid, however, need ringing A higher refractive index, namely, 1 87, is obtained with a solution of phosphorus in methylene iodide, but the golden yellow liquid soon becomes cloudy on exposure to air

Wilfrid Marshall
Pharmacological Laboratory,
University of Aberdeen,
Mar 4

Isolation of the Radical Ethyl

We have been successful in preparing the free radical ethyl (in the same way as we obtained the free methyl) by decomposing lead tetraethyl in a hydrogen stream at reduced pressure by means of heat (compare Paneth and Hofeditz, *Ber Deuts Chem Gesells*, 62, 1335, 1929 Nature, 124, 161, 1929) The free ethyl is not less aggressive than the free methyl It converts the metals zinc, cadmium, antimony, and lead into volatile compounds which (under atmospheric pressure and at room temperature) form limpid liquids The zinc compound has been studied in some detail the presence of ethyl could be established by converting the ethyl groups into alcohol and identifying the latter by the iodoform test, the metal revealed itself as zinc free from lead, and the melting and boiling point of the compound coincided with those known for zinc diethyl As the zinc metal before conversion into this compound had been located at a distance from the place of decomposition of the lead tetraethyl, it seems to be demonstrated that the radical ethyl can be obtained in the free state and carried by a gas stream over several centimetres before recombination takes place

A fuller report of the experiments on free ethyl will be published in the *Berichte der Deutschen Chemischen Gesellschaft*

F Paneth
W Lautsch
Chemisches Institut der Universität,
Königsberg i Pr, Mar 17

The Maladaptation of Trout Spermatozoa to Fresh Water

The finding of Prof Huxley (Nature, Mar 29) that the addition of salts to fresh water prolongs the period of activity of trout spermatozoa confirms results of other workers There are several papers bearing on this subject, but those of Scheuring [1] [2] and Gaschott [3] treat specifically of the spermatozoa of the trout and salmon Analogous results have been obtained with amphibian material, and it is perhaps general that an osmotic pressure approximating to that of the tissues is favourable to the maintenance of the integrity of the cell, notwithstanding the fact that fertilisation may normally take place in a hypotonic medium The problem is, however, not a simple one, and the specific effect of various solutes, more particularly their ions, on the cell must be taken into consideration

Apart from the problems of physiological interest which are raised, the results have, as Prof Huxley suggests, an interesting bearing on the evolution of species in their transition from marine to estuarine, fluvial, and terrestrial forms The necessity for a reduction in the time of exposure of the gametes or their protection from the external environment is perhaps reflected in many modifications of sexual mechanisms and behaviour Copulation with internal fertilisation is the most complete solution of the difficulty At present I am collecting references and experimental data which I hope will enable me to write more explicitly on the subject in the near future

Arthur Walton
School of Agriculture,
Cambridge, Mar 31

[1] Scheuring, L Biologische und Physiologische Untersuchungen an Forellensperma *Arch. Hydrobiologie* Suppl 4 pp 181 318, 1925
[2] Scheuring, L Weitere biologische und physiologische Untersuchungen an Salmonidensperma *Zool Jahrb*, 45, pp 651 706, 1928
[3] Gaschott, O Beiträge zur Reizphysiologie des Forellenspermas *Arch Hydrobiologie* Suppl 4, pp 441 478, 1925

Mating during Pregnancy in the Mouse

It would seem that mating during pregnancy in the rat and mouse is an exceedingly rare occurrence Nelson (1929) [1] has recorded one instance in the rat, and Long and Evans (1922) [2] refer to two others So far as we know, mating during pregnancy has not been recorded in the case of the mouse It seems worth while to place on record, therefore, the following facts which have presented themselves to our notice during the course of an experiment in which 100 females have been examined daily for six months for vaginal plugs—evidence of mating The animals were continuously kept with males so that every opportunity for mating was given

Date when 1st Vaginal Plug was noticed	Date when 2nd Vaginal Plug was noticed	Date of Parturition	Number in Litter	Number of Days between 1st and 2nd Vaginal Plugs
22 8 29	7 9 29	10 9 29	4	16
5 8 29	9 8 29	24 8 29	6	4
2 10 29	12 10 29	21 10 29	8	10
20 9 29	5 10 29	10 10 29	8	15
27 10 29	5 11 29	15 11 29	8	8
25 12 29	8 1 30	12 1 30	5	14

In our experience, then, out of 100 females under observation for six months, 6 presented trustworthy evidence that during pregnancy mating had occurred without in any way affecting the course of pregnancy It is seen that during the course of a single pregnancy mating occurred only once in our experience, and that it occurred not always at the same time during pregnancy though always at a time when, had the animal not been pregnant, it would have been expected

F A E Crew
L Miskaia

[1] Nelson, Warren O Œstrus during Pregnancy *Science*, vol 70. No 1819 Nov 1929.
[2] Long and Evans. The Œstrous Cycle in the Rat. *Memoirs Univ. Calif.*, p 58, 1922.

Reaction of the Phagocytes of Arthropods to their Internal Insect Parasites

By Dr W R THOMPSON, Imperial Bureau of Entomology

IN his celebrated work on the pathology of inflammation, first published in 1892, E Metchnikoff[1] made a general survey of the phenomena of phagocytosis in the animal kingdom and pointed out that there exist between the various groups very striking differences in the behaviour of the white blood cells towards internal parasites He stated that among the Arthropods the phagocytic reaction is, in general, rather feeble, and suggested that this condition is perhaps related to the development of a chitinous cuticula in these animals, and that since this cuticula prevents the entrance of parasitic organisms the defensive activity of the phagocytes is less marked than in organisms which do not possess this protection Several years later L Cuénot, in his "Études sur la physiologie des orthoptères", criticised the views of Metchnikoff on the ground that the cuticular armature of the Arthropods, in spite of its thickness, is a very inefficient means of defence against parasites Cuénot had, indeed, observed that the parasites of Arthropods in their habitual hosts are not usually attacked by phagocytes, but he explained this fact on the hypothesis that the parasites have developed the power of resisting the phagocytes, by which they would otherwise be destroyed According to this idea, when a new parasite arrives in an Arthropod it ought to be attacked by the phagocytes and destroyed by them

In a later paper Cuénot[2] modified these views to some extent, having found that living parasites of Arthropods may be surrounded by the blood cells, although the encystment has not, necessarily, a fatal result Cuénot did not, however, put forward any satisfactory evidence for the view that the insect parasites of Arthropods are ordinarily attacked by phagocytes when in a healthy and living condition

In his admirable studies of the biology of the Diptera parasitic on insects (1898, 1910), J Pantel,[3] whose conclusions were based on the study of a large number of species, stated that as a general rule the free and healthy larvæ of entomophagous parasites are not attacked by phagocytes The phagocytes of the infested organism, according to Pantel, are always inactive in relation to normal parasites They intervene in cases of bacterial infection by the integumental sheath and accumulate about sick or dead parasites or moult skins

The results of my own studies on this subject, of which a summary up to that date was published in 1915,[4] confirm those of Pantel Nevertheless, the view that even in Arthropods the phagocytes constitute a defensive mechanism against parasitic enemies of all kinds, that the destruction and death of parasites entering hosts to which they are not adapted is due to phagocytic attack, and conversely, that the process of adaptation to a specific host consists essentially in the elaboration by the parasite of anti-phagocytic secretions or the development by it of structures constituting a defence against the blood cells, still continues to be advocated To give only one example, this is the view put forward by Caullery[5] in his book on parasitism and symbiosis (chap x p 250) It seems, therefore, desirable to give a brief general summary of the facts concerning the tissue reactions of Arthropods to their internal insect parasites No attempt will be made in this article to discuss the relation between the blood cells of Arthropods and protozoan, fungous, or bacterial parasites, because the physiological relations between these organisms and the hosts they infest are very different from the relations between internal insect parasites and their hosts

Taking, then, the internal insect parasites of Arthropods, which infest their hosts, for the most part, in the larval condition, we may classify them according to the exact nature of their relations with their hosts into three principal groups

1 The first group includes those parasites the larvæ of which lie free within the body cavity of their host To this group belong the vast majority of the internal Hymenopterous parasites and a minority of the Diptera So far as I have observed, the living larvæ of parasites of this group are never attacked by phagocytes There is no particular reason to suppose that they *repel* the phagocytes The phagocytes seem simply to be *indifferent* to the parasite larvæ as they are to the organs of the host itself

2 The second group comprises the parasites which penetrate into some organ of the host, in which they pass a considerable period without, however, causing any extensive and rapid destruction of tissue Examples of this type are the Diptera *Sturmia scutellata* R D, which lives during the first larval stage in the muscle fibre of the caterpillar which it infests, *Sturmia sericariæ* Corn, the parasite of the silkworm, which lives in a ganglion of the ventral nerve chain of the host, and *Blepharidopsis nemea* Meig, which lives in a lobe of the fat body The larvæ of these species develop slowly, absorbing nutriment from the organs into which they have penetrated, and sometimes cause marked pathological changes, but no rapid and extensive destruction of tissue The reactions produced in the host tissue which they enter are in no way either advantageous to the host itself or detrimental to the parasite, on the other hand, no phagocytic accumulations are formed around the bodies of these larvæ

3 The third group of parasites includes species which enter into anatomical relations with the host in such a way that extensive and sometimes rapid destruction of tissue is produced Such are the numerous Tachinids which enter the body of the host through the skin and leave the extremity with the posterior spiracles embedded in the body-wall, and those which after entering force the posterior extremity either into the lumen of a trachea or through the body-wall in order to obtain access to the outer air. The Tachinid, *Plagia trepida* Meig, which enters a muscle fibre in the first larval stage and immediately begins to devour the muscular substance, can also be placed in this group Around

larvæ of this kind, or adjacent to them, accumulations of phagocytes are frequently observed These accumulations appear to depend upon the diffusion into the blood of substances from the destroyed tissues, or, as Pantel suggests, on the diffusion of toxins from bacteria which have penetrated into the body of the caterpillar through the opening made by the parasite Sometimes the accumulations of phagocytes are very extensive and completely surround the parasite, but they never penetrate into its body, nor is there any good evidence that they impede its development

The statements just made summarise the data in what may be called cases of natural parasitism As will be seen, they afford no support for the view that the adaptation of the internal insect parasite to its host consists essentially in the development of substances destined to repel the phagocytes, or in structures designed to afford protection from their attack To test this point, I carried out several years ago a number of experiments, during which I introduced into the body cavity of living insects sarcophagous or parasitic larvæ, which are never found in the species concerned in Nature In some of these experiments the parasites introduced into the unfamiliar hosts lived and developed in the normal way, and in that case were never molested by the phagocytes In other cases they died and the phagocytes gathered around their bodies except when the host was in a very diseased or exhausted condition, but in no case was any accumulation of phagocytes observed around a living parasite The results of these experiments were confirmed by others, in which the larva of the internal parasite was killed without wounding the host, by blocking up the opening of its respiratory funnel No accumulation of phagocytes around the parasite larva was observed in such cases so long as it remained alive, but after its death, blood cells began at once to accumulate about it

It has long been known that phagocytes become extremely abundant during the pupal period and are found during this time migrating into and destroying the degenerating larval tissues, but there is no reason to suppose that this period is especially dangerous for internal parasites, or that they require any protective secretions or structures in order to enable them to survive it *Chalcis Fonscolombei* Duf, the parasite of Sarcophagids, which attacks its host during the late larval stage and emerges from the puparia, does not possess any sack The same thing is true of *Alysia manducator* Panz, the Braconid parasite of *Lucilia sericata* Meig On the other hand, there is no reason to suppose that the trophamnion which occurs in some pupal parasites is a protection against phagocytic attack, for there are many parasites which live within a membrane of this type, but infest their host only during the larval period, as, for example, the polyembryonic Encyrtids

Finally, the idea that phagocytes break down the tissues of the parasites they attack and that the substance of the latter is built up into the tissues of the host, seems also to be contrary to the facts The accumulation of phagocytes about the body of a dead parasite appears to continue for a considerable time, but it is not certain that the phagocytes ever disperse Dead eggs or larvæ may often be found many months after their death has occurred, surrounded by a dense ball of phagocytes, many cells thick, of which the internal layers show manifest signs of cellular degeneration Within these balls the dead larvæ disintegrate, but the action of the autolytic enzymes would produce this effect without the intervention of the phagocytes, which do not, so far as I have observed, actually penetrate into the bodies of the parasites

[1] E Metchnikoff, Leçons sur la pathologie comparée de l Inflammation (Paris Masson 1892)
[2] L Cuénot, *Arch de Biol*, 14, 1er fasc, 1895, and 15, 1897, Paris—Brussels
[3] J Pantel, *La Cellule*, 15, 1er fasc, 1898 and 26, 1er fasc, 1910, Louvain
[4] W R Thompson *Bull Soc Zool France* 40, p 63, 1915
[5] M Caullery, Le parasitisme et la symbiose (Paris Doin, 1922)

Clerk Maxwell and the Michelson Experiment

We have received from Mr. Rollo Appleyard, author of "Pioneers of Electrical Communication", a copy of correspondence that he has had with Prof P Lenard, of Heidelberg, on the association of Clerk Maxwell with the Michelson experiment Prof Lenard suggested that although it is universally acknowledged that Maxwell played an important part in instituting the inquiry, it would be helpful if references could be obtained to Maxwell's own account of his views Mr Appleyard accordingly furnished the following particulars, which Prof Lenard requested might be published in Nature, in order that full credit might be given to Clerk Maxwell for the part he took in inspiring the Michelson experiment

At a meeting of the Royal Society on Jan 6, 1880, Prof G Stokes, the secretary, communicated a paper by Prof Clerk Maxwell, who had recently died, the paper was a letter to Prof D P Todd, who was then Director of the American Ephemeris This letter suggested that careful observations of the times of the eclipses of Jupiter's satellites, when Jupiter was in different directions as seen from the earth, might show whether the velocity of light varied in different directions, owing to the motion of the solar system through the ether Clerk Maxwell admitted that he was not an astronomer, and was doubtful whether the eclipses could be timed with sufficient accuracy to test the suggestion He thought it would probably be agreed that the only class of observations that would be of sufficient accuracy for the purpose would be the photometric ones that were made at Harvard College Observatory, or others on similar lines Even with these Prof R A Sampson found puzzling anomalies, due perhaps to changes in the character of Jupiter's surface, which is of a cloudy nature, and apparently subject to variations in its transparency

Clerk Maxwell had thought that terrestrial ex-

periments would be useless to solve the problem, owing to the extreme smallness of the quantity to be measured, which is one of the second order However, his letter led to an article by Prof A A Michelson, which appeared in the *American Journal of Science* for August 1881, extracts from which are printed below It will be seen that Michelson refers to Maxwell's suggestion, and notes that the second order quantity, which Maxwell had considered too small to determine, is "easily measurable" He then gives an outline of what we now know as the Michelson experiment

Clerk Maxwell's name therefore deserves mention, since apparently his suggestion, though not fruitful in the manner that he hoped, had some effect in bringing about the famous experiment, the result of which laid the foundation of the theory of relativity

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Extract from *American Journal of Science*, Series (3), Vol 22, p 120, August 1881

Art XXI —*The Relative Motion of the Earth and the Luminiferous Ether*

By Albert A Michelson, Master, U S Navy

Let V be the velocity of light

v = the speed of the earth with respect to the ether

D = the distance between the two points

d = the distance through which the earth moves while light travels from one point to another (on the earth's surface)

d_1 = the distance earth moves while light passes in the opposite direction

Suppose the direction of the line joining the two points to coincide with the direction of earth's motion and let

T = time required for light to pass from the one point to the other, and

T_1 = time required for it to pass in the opposite direction Further, let

T_0 = time required to perform the journey if the earth were at rest

Then

$$T=\frac{D+d}{V}=\frac{d}{v}, \quad \text{and} \quad T_1=\frac{D-d}{V}=\frac{d_1}{v}$$

From these relations we find

$$d=D\frac{v}{V-v}, \quad \text{and} \quad d_1=D\frac{v}{V+v},$$

whence

$$T=\frac{D}{V-v} \quad \text{and} \quad T_1=\frac{D}{V+v},$$

$$T-T_1=2T_0\frac{v}{V} \text{ nearly, and}$$

$$v=V\frac{T-T_1}{2T_0}$$

If now it were possible to measure $T-T_1$, since V and T_0 are known, we could find v, the velocity of the earth's motion through the ether

In a letter, published in NATURE shortly after his death [read before the Royal Society on Jan 6, 1880, see NATURE, Jan 29, 1880, p 314], Clerk Maxwell pointed out that $T-T_1$ could be calculated by measuring the velocity of light by means of the eclipses of Jupiter's satellites at periods when that planet lay in different directions from earth, but that for this purpose the observations of these eclipses must greatly exceed in accuracy those which have thus far been obtained In the same letter, it was also stated that the reason why such measurements could not be made at the earth's surface was that we have thus far no method for measuring the velocity of light which does not involve the necessity of returning the light over its path, whereby it would lose nearly as much as was gained in going The difference depending on the square of the ratio of the two velocities, according to Maxwell, is far too small to measure

The following is intended to show that with a wave-length of yellow light as a standard, the quantity—if it exists—is easily measurable Using the same notation as before, we have—

$$T=\frac{D}{V-v}, \quad \text{and} \quad T_1=\frac{D}{V+v}$$

The whole time occupied therefore in going and returning [is]

$$T+T_1=2D\frac{V}{V^2-v^2}$$

If, however the light had travelled in a direction at right angles to the earth's motion it would be entirely unaffected, and the time of going and returning would be therefore

$$2\frac{D}{V}=2T_0$$

The difference between the times $T+T_1$ and $2T_0$ is

$$2DV\left(\frac{1}{V^2-v^2}-\frac{1}{V^2}\right)=\tau,$$

$$\tau=2DV\frac{v^2}{V^2(V^2-v^2)} \text{ or nearly } 2T_0\frac{v^2}{V^2}$$

In the time τ the light would travel a distance

$$V\tau=2VT_0\frac{v^2}{V^2}=2D\frac{v^2}{V^2}$$

That is, the actual distance the light travels in the first case is greater than in the second, by the quantity $2D\frac{v^2}{V^2}$

Considering only the velocity of the earth in its orbit, the ratio

$$\frac{v}{V}=\frac{1}{10,000} \text{ approximately, and}$$

$$\frac{v^2}{V^2}=\frac{1}{100,000,000}$$

If D = 1200 millimetres, or in wave lengths of light, 2,000,000, then in terms of the same unit,

$$2D\frac{v^2}{V^2}=\frac{4}{100}$$

If, therefore, an apparatus is so constructed as to permit two pencils of light, which have travelled over paths at right angles to each other, to interfere, the pencil which has travelled in the direction of the earth's motion, will in reality travel $\frac{4}{100}$ of a wave-length farther than it would have done were the earth at rest The other pencil being at right angles to the motion would not be affected

In conclusion, I take this opportunity to thank Mr Graham Bell, who has provided the means for carrying out this work, and Professor Vogel, the Director of the Astrophysikalisches Observatorium [in Potsdam], for his courtesy in placing the resources of the laboratory at my disposal

Radio Direction-Finding by Transmission and Reception *

By Dr R L Smith Rose

Transmission Over Sea and Night Error

WHEN the transmission is entirely over sea the minimum range for night errors to be experienced is increased to about 100 miles due to the diminished attenuation of the direct wave resulting from the superior conductivity of sea water At distances greater than the minimum already mentioned the errors increase in magnitude for distances up to a few hundred miles When the distance is very great it is possible for much of the downcoming radiation to arrive at a very large angle of incidence For example a section of the earth and the ionised layer drawn to scale is shown in Fig 4 From this it is evident that at distances of 1780 and 3560 miles it is just possible for radiation leaving the transmitter horizontally to return to the earth s surface at grazing incidence It is likely that the intensity of such waves after two reflections from

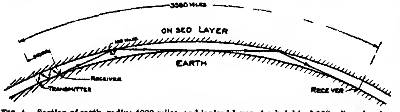

FIG 4 —Section of earth radius 4000 miles and ionised layer at a height of 100 miles showing the paths of waves from a transmitting station and two receivers at distances of 240 miles and 3560 miles

the ionised layer and one from the earth s surface will be much greater than that of waves which have undergone a greater number of reflections and thus it is the downcoming wave arriving horizontally which will be chiefly responsible for the received signal intensity It is evident that only small variations in direction finder bearings will be expected under such conditions

Now the distance of 3500 miles is approximately that between the National Physical Laboratory Teddington and some of the high power transmitting stations in the United States of America A series of systematic observations carried out on two of these stations operating on wave lengths of 16 4 km and 16 8 km showed that the proportion of bearings correct to within 2° was 100 per cent in one case and 94 per cent in the other the maximum error in the second instance being 3 4° Under similar conditions observations made on several European transmitting stations using wave lengths between 14 km and 19 km at distances of 75—760 miles showed maximum errors in bearings of 12° to 28° while the proportion of bearings correct to within 2° was only 16—63 per cent Reference to Fig 4 shows that this result is to be expected since at a range of 240 miles for example the angle of incidence of waves arriving at the receiver after two deflections from the ionised layer is of the order of 35°

* Continued from p. 532

Elimination of Night Errors in Direction Finding

It will be evident that any receiving system which is unaffected by horizontal components of electric force will be free from night errors even though the vertically polarised downcoming waves still produce variations in received signal strength A direction finding receiving arrangement which fulfils this condition was patented by Adcock in 1919 but it does not appear to have received practical consideration until Mr Barfield and I experimented with it in 1926 The simplest form of the Adcock aerial system is a pair of spaced vertical aerials arranged to rotate about a central vertical axis thus forming the equivalent of the single closed coil direction finder By making all connexions to the centres of the aerials the horizontal members of the system are compensated so that no electromotive force is induced in the receiver by a horizontal electric force Preliminary tests with this direction finder carried out a few years ago showed that the system was effective in considerably reducing the magnitude of the night variations experienced with the closed loop system The continued development of the system as a practical form of direction finder free from night errors is still in progress

The Rotating Loop Beacon

As an alternative to the direction finding schemes outlined above the directional part of the wireless system may be transferred from the receiving to the transmitting end This is effected in the rotating loop beacon system developed by the Royal Air Force which employs a vertical closed loop transmitter arranged to rotate about a vertical axis at a uniform speed of one revolution a minute As the loop rotates the field radiated in any given direction varies according to a cosine law passing through successive maximum and minimum values at intervals of 15 seconds When the plane of the loop is perpendicular to the geographical meridian a characteristic signal is emitted by the beacon which may be termed the north point The observer at a distant receiving station upon hearing this signal starts a chronograph As the beacon rotates the intensity of the received signal varies and will ultimately pass through a minimum or zero at which instant it is known that the plane of the transmitting loop is at right angles to the great circle through transmitter and receiver If the reading of the chronograph is observed at this instant of minimum signal intensity it is evident that the bearing of the transmitter from the receiver can be obtained from a simple calculation

It is to be noted that since the radiation from the coil is symmetrical about its plane, a second minimum will be obtained after a rotation of 180° from the first. With the beacon making one revolution per minute, therefore, a line bearing is obtainable in the above manner every half-minute. To fix the position of a receiving station it is necessary to obtain line bearings from two or more beacons. Since the timing process mentioned above is but an intermediate step in taking a bearing, it is convenient to provide a stop watch or chronograph for the purpose, with a dial specially engraved in degrees and points of the compass.

An application of the principle of reversibility in direction-finding makes it evident that the performance of a rotating loop beacon transmitter can be largely predicted from the results and experience obtained with receiving loop direction finders. Thus, a rotating loop beacon when erected on the same site as the direction finder will give observations at a distant receiver which will be subject to the same type of local error and night variations, for example, as the bearings observed on the direction finder when the distant receiving aerial is used for transmission. I have confirmed these deductions in the investigation during the past two or three years, of the performance of a rotating beacon erected at Fort Monckton, near Gosport. In order to ascertain the trustworthiness of this type of rotating beacon as an aid to marine navigation, a number of tests were carried out in ships crossing the English Channel between Southampton and Havre, and Southampton and Jersey. Using the ship's ordinary wireless receiver, observations of the bearing of the beacon were made at intervals during each trip and compared with the bearing as given by the captain of the ship.

As a result of tests conducted on these lines, it was found that in the majority of cases the estimated and observed bearings agreed to within from 2° to 4°. Signs of night effects in the shape of indistinct signal minima and wandering bearings were observed at ranges exceeding 60 miles. In many cases at night and during misty weather when visibility was very poor, the ship was navigated by dead reckoning, and in these circumstances it was frequently considered that the bearing obtained from the rotating beacon was the more accurate. Some of the test runs made between Southampton and Jersey were carried out in a ship fitted with a direction finder of the Marconi Bellini-Tosi type, and the opportunity was thus provided of comparing the two systems of obtaining wireless bearings under actual sea going conditions. The observations carried out in this manner showed that in the majority of cases the bearings obtained with the direction finder and from the rotating beacon agreed to within 5°. In some cases, however, due probably to the pitching and rolling of the ship, the accuracy of the direction finding bearing was inferior to that obtained from the rotating beacon.

As a result of the success of the experiments carried out with the Gosport station, a more permanent type of rotating loop beacon transmitter was installed at Orfordness and put into operation in June 1929. During the few months that this station has been working, a considerable number of reports have been received from various ships giving the results of observations made on transmissions from the beacon. These reports show that the inauguration of this beacon service has been very well received by the mercantile marine. With the ordinary type of ship's receiver adjusted for continuous wave reception, accurate wireless bearings are obtainable at distances of 50–100 miles. Ships fitted with a more elaborate receiver have reported good and consistent bearing observations up to ranges of 250 miles. At such long ranges, however, it is possible that the observed bearings may be subject to night errors in a manner similar to that observed in wireless direction finding under the same conditions.

From the similarity of performance of the two systems of direction-finding, it would be expected that the elimination of the horizontal components of the transmitting loop would be of advantage in eliminating or reducing the magnitude of night errors or effects observed when using the rotating beacon. A theoretical analysis of the case has shown this deduction to be justified, and experiments are now in progress towards the development of a rotating beacon transmitter with an aerial system of which only the vertical members are active in producing radiation of electromagnetic waves. If these experiments lead to successful results, it is probable that rotating beacons can be erected with a trustworthy working range of the order of 500 miles, supplying wireless bearings at any time or season with an accuracy which is adequate for both aerial and marine navigation.

Obituary

Sir William McCormick, G.B.E., F.R.S.

Few if any of the men interested in education since the days of the War have been better known to the vice-chancellors and treasurers of the universities of Great Britain than the late Sir William McCormick. None has had so complete a knowledge of their financial difficulties and of the disastrous effects on educational efficiency of their want of means, and no one has done more to help than he, by his sympathetic treatment of the problems placed before him, his wise advice based on his long experience, and his cordial appreciation of the value of the efforts made to fit the universities for their task, whether it be that of advancing knowledge, or of educating the students that fill their lecture rooms and laboratories. To all, his death on Mar. 22 means a very heavy loss.

McCormick was born on April 29, 1859, and educated at the Universities of Glasgow, Göttingen, and Marburg. For a short time he lectured on mathematics, but the study of the English language and literature soon attracted him, and he became, and continued to the end, a serious student of Chaucer.

After holding various lectureships on English at Glasgow, he was appointed professor of English in University College, Dundee, and then later, when the Carnegie Trust for the Universities of Scotland was established, he was chosen as its first secretary

But at this time new universities and university colleges were being established in England and Wales, and the question of State assistance to these became urgent A Treasury Committee, of which McCormick was a member, was set up to deal with this At a later date (1909) the Committee was transferred to the Education Office and he was made chairman In 1916 the Committee was again transferred to the Treasury as the University Grants Committee and Sir William remained chairman until his death The Committee was "to inquire into the Financial Needs of University Education in the United Kingdom, and to advise the Government as to the application of any grants that may be made by Parliament towards meeting them"

Figures perhaps give the clearest account of the magnitude of this work The recurrent grants made by Parliament are as follows 1913–14, £361,623, 1919–20, £889,000, 1930–31, £1,800,000 Between these last two periods, Oxford and Cambridge were added to the bodies receiving grants

The following words of a letter from Mr G H A Wilson, Master of Clare and member of Parliament for the University of Cambridge, of which he was Treasurer, give some indication of McCormick's method and of the value of his help

"By the death of Sir William McCormick the University of Cambridge has lost a sympathetic friend and a wise counsellor As head of the University Grants Committee of the Treasury, he always gave the greatest help and most valuable advice to the University in the many questions which were involved when the grant from the Treasury to the University was made

"The fears which had been expressed that the receipt of a Government grant might involve undue interference in the affairs of the University by a Government Department proved, under the wise and helpful guidance of Sir William McCormick, to be quite baseless Whilst prepared at all times to give advice when sought, he always maintained that the University should be left with the greatest possible freedom to manage its own affairs He was ever willing to meet suggestions as to the forms in which the accounts of the University might be modified to meet the special conditions existing at the University without departing from the necessity that those accounts should present a clear and accurate statement of University finance suitable for the needs of the Treasury"

To quote some words written since his death by one who, in earlier years, was his assistant in much of this work "His constant sympathy and wise counsel were always given with that peculiar charm that distinguished his personality The thing I enjoy saying of him most—and I say it with complete sincerity—is that if there was anything I did which was worthy, the credit and more than the credit was accorded to me, if I made mistakes (and there were plenty) he shouldered at once the entire blame That is the sort of thing that makes a junior worship a chief"

Meanwhile, important changes were in progress, the War had brought home to Great Britain the national importance of scientific research In May 1915 the Presidents of the Boards of Trade and of Education received a deputation from the Royal Society and other learned societies urging "Government assistance for scientific research for industrial purposes, the establishment of closer relations between manufacturers and scientific workers and teachers, and the establishment of a National Chemical Advisory Committee for these purposes" McCormick had been a member of a small Committee appointed by Mr Pease, President of the Board of Education, earlier in the year, which was responsible for the scheme ultimately adopted The Presidents replied to the deputation that the Government proposed to establish machinery with wider powers than those suggested by the memorialists, and a week later, when introducing the Board of Education estimates, Lord Gainford (then Mr Joseph Pease) announced the impending appointment of an Advisory Council for the supervision and encouragement of scientific research, particularly in relation to industry McCormick became chairman of the Council of eight members, only one of whom—Sir Richard Threlfall—is still with us Its first meeting took place on Aug 17, 1915 The order establishing the Council was signed by Mr Henderson, who on the change of Government had taken Mr Pease's place at the Board of Education

Even before the change, however, further discussions with the Government had taken place, and in these Sir William had borne a full share The Council had at first been instituted, for reasons of convenience, under the ægis of the Board of Education, but it had been decided—as one of the last acts of Mr Asquith when Prime Minister—that it should be established as a separate department under the Lord President of the Council, with its own offices This was announced in December 1916 by Lord Crewe, then Lord President

The first duty of the Advisory Council was to form a scheme or programme for its own guidance in recommending proposals for research, and for the guidance of the Committee of Council in allocating such State funds as were available, while to finance the work a grant of a million pounds was made, to be expended in accordance with these directions McCormick was present at the interview with the Chancellor at which the grant was made, and in his humorous way described the need and the discussions he had had with manufacturers when planning how best to meet that need "When people are starving," he said, "it is no use going to them with the Bible in one hand without a loaf of bread in the other."

To form a scheme was no easy task A Council of seven distinguished men of science, all of them fellows of the Royal Society, with a professor of English literature as chairman, set to organise under the pressure of a great war the application of science to industry The Council was fortunate

both in its chairman and its secretary, the reports of the last fourteen years give a record of its work, this is not the opportunity to attempt any detailed account Individual effort has been hitherto the basis of success of an English manufacturer, who has ever been an individualist It was clear at the start that grants to individual manufacturers would not accomplish the aims of the Council Co-operation in research was a new idea, at the same time, if it could be arranged, it was the one plan which seemed really hopeful, and thus research associations came into being, and in numerous cases have proved, by the work already done, the foresight of those to whom their existence is due, and the wisdom of the chairman who, for the past fourteen years, has guided the Council responsible for the supervision and approval of their work

How wise he was, with what skill and tact he guided that work, is known to all who were privileged to serve under him on the Council He has set it, it is true, on the right track, but the chairman himself, with his determination to go forward, along the path mapped out with so much thought and care, his realisation of the importance of its task, and his confidence that in the end success would come, will be greatly missed

McCormick was not a scientific man, but he has done more for science than many a professor in the subject, and it was a cause of no small pleasure to his friends—not least to the president and council of the Royal Society themselves—when some two years since the president was able to announce the recommendation of the Council, a recommendation unanimously approved, that it was desirable "in the interest of the advancement of Natural Knowledge" that he should be elected a fellow of the Royal Society under the special statute defining such elections Can we describe him better than the words of his own Chaucer

A knyght ther was and that a worthy man,
That fro the tyme that he first bigan
To riden out, he loved chivalrie,
Trouthe and honour, fredom and curteisie

He never yet no vileynye ne sayde,
In al his lyf, unto no maner wight
He was a verray parfit, gentil knyght

R T G

Prof W Robinson

Prof Wilfred Robinson, professor of botany at University College, Aberystwyth, died on Mar 7 after several months of ill-health He was born at Hull in 1884 and early became interested in botany, for his father, J F Robinson, a schoolmaster, was author of the "Flora of the East Riding of Yorkshire" He entered University College, Nottingham, and took his London B Sc (Hons) in botany His first post was science master at Penketh Friends' School, Warrington In 1912 he was awarded a research studentship at the Victoria University and became successively Platt scholar in botany, lecturer in botany, and assistant to the professor of cryptogamic botany, and then, in 1916, senior lecturer He was appointed to the chair at Aberystwyth in 1926

Robinson was a botanist of wide interests, keen in the field and careful in the laboratory During the War he worked on the microscopic cell wall characteristics of mechanical strains in timber, a matter of importance in the construction of aeroplane propellors His main interests for some time, however, were in plant pathology, and he visited the United States in 1924 on behalf of the Cotton Research Association to investigate the diseases of the cotton plant Several of his researches dealt with the physiology of fungi but, on going to Aberystwyth, he began to study the physiology of seaweeds and the life histories of some of the less common genera of the neighbourhood

With such wide interests and a natural flair for teaching, Robinson had an inspiring influence on his students and it is a great loss to cryptogamic botany that he was not spared long enough to enjoy the results of his industry and influence He took an active part in British Association matters and was recorder of Section K (Botany) until a few weeks ago

Dr Archibald Roderick Fee died on Feb 23 of septicæmia and broncho pneumonia, following the extraction of a tooth on Feb 15 His death deprives the subjects of experimental physiology and experimental biology of an active and devoted worker Dr Fee was only twenty four years of age at the time of his death, and his home was in West Burnaby, British Columbia He was a man of outstanding personality and possessed remarkable energy and great personal charm He came to England at the age of twenty with a degree from the University of British Columbia, and had already been engaged there in work for the Board of Fisheries which took him into uncharted waters of north western Canada He was a pupil in Great Britain of the late Prof E H Starling, who, like all his colleagues, had the highest opinion of Fee's ability and promise Dr Fee, at the time of his death, held a Beit Memorial Research Fellowship

We regret to announce the following deaths

Dr Henry Faulds, an authority on the finger print system of detecting criminals, and author of "Dactylography", on Mar 19, aged eighty six years

Prof Augustine Henry, formerly professor of forestry at University College, Dublin, on Mar 23, aged seventy two years

Dr J Y Mackay, principal and formerly professor of anatomy at University College, Dundee, on Mar 30, aged seventy years

Dr J W Robertson, C M G, first Commissioner of Agriculture and Dairying for the Dominion of Canada, and a pioneer of agricultural education in Canada, on Mar 19, aged seventy two years

Prof E G R Waters, professor of Romance languages in the University of Oxford, and an authority on British Micro Lepidoptera, on Mar 23, aged thirty-nine years

News and Views.

The impending resignation of Prof J Arthur Thomson from the chair of natural history in the University of Aberdeen severs the connexion with those occupants of the chair who taught both zoology and geology In 1908 the arrangement whereby the Department of Natural History was held to cover both zoology and geology came to an end when a separate lectureship in geology was instituted Prof J Arthur Thomson was appointed to the chair in 1899, and thus carried on the old arrangement for nine years The title of the original chair in Marischal College and University was that of civil and natural history, but when in 1860 the two Universities of King's College, Old Aberdeen, and Marischal College, Aberdeen, were united under the Universities (Scotland) Act, 1858, the chair became one of natural history in the University of Aberdeen The occupant of the chair of civil and natural history at the date of amalgamation was James Nicol, who had been appointed in 1853 Prof Nicol resigned and died in 1878, when J Cossar Ewart was appointed Prof Ewart resigned the chair in 1882 on his appointment to the chair of natural history in the University of Edinburgh He was succeeded by Henry Alleyne Nicholson, who held the chair until his death in 1899

Prof J Arthur Thomson, after graduating at the University of Edinburgh, proceeded to the Universities of Jena and Berlin, and was thereafter appointed lecturer in zoology and biology at the School of Medicine in Edinburgh, from which post he was appointed to the Aberdeen chair in 1899 The complete mastery of his subject, together with the lucidity and charm of his style, have earned for him a wide world reputation both as a lecturer and as a writer The Universities of Edinburgh and McGill conferred on him the honorary degree of LL D In 1915, he delivered the Gifford Lectures at St Andrews, and he has repeatedly been asked to lecture in the United States He was Terry lecturer at Yale University, and Morse lecturer at the Union Seminary, New York, while he is at present lecturing in the Zoology Department of the University of California at Berkeley and Los Angeles Particulars of the conditions on which the chair of natural history in the University of Aberdeen is held may be obtained from the Secretary of the University

Rumours concerning the future of the chair of organic chemistry at University College, London, have already been the subject of comment and protest in the correspondence columns of Nature It is not surprising that the suggestion to abolish the title of professor of organic chemistry should arouse suspicion that the future of organic chemistry itself at that college will thereby be jeopardised, and it is even less remarkable that those who have at heart the welfare of industries dependent on the progress of that branch of chemistry should be seriously perturbed by the further belief that a professor who is not an organic chemist may be appointed to fill the chair falling vacant by Prof R. Robinson's transfer to Oxford A letter recently addressed by the secretary of the Association of British Chemical Manufacturers to the Provost of University College expresses concern at the effect of such a policy on chemical industry, pointing out that intensive and continuous investigations in organic chemistry are essential for maintaining and improving our industrial position, and that any diminution therein of the facilities for instruction and research, which present experience shows to be still inadequate, may result in our once more becoming dependent on other countries for much that is vital to the health and prosperity of the nation

We have been informed by the Provost of University College, London, that henceforward the two chairs will be distinguished simply as the first and second chairs of chemistry, and that this must not be regarded as in any way affecting the position of organic chemistry in the College, it only secures to the College the freedom to make such recommendations as seem best in the interests of the College and of chemical studies as a whole It appears to us that the only reasons which would justify a change in the title of a position of such influence and standing would be inaccuracy of description of existing conditions and intention to vary them in the future, the former alternative is inapplicable, and it must therefore be concluded that the Provost's statement envisages the latter This can only mean that the position of organic chemistry at University College, London, is indeed affected, it may lose the status which is its due, it may lose that support and that momentum which can be fully given only by one of its own disciples, and its loss would be felt far beyond the limits of jurisdiction of the University of London It may happily be, however, that there is no intention of allowing organic chemistry to suffer any such disabilities, in which case it is difficult to understand why any change should ever have been proposed

The centenary of the death of Henry Hill Hickman was celebrated at a reception held at the Wellcome Historical Medical Museum on April 2, when Lord Dawson of Penn, president of the Royal Society of Medicine, gave an interesting address on this English pioneer in anæsthesia Hickman was born on Jan 27, 1800, near Ludlow in Shropshire, and qualified as a member of the Royal College of Surgeons twenty years later Like Edward Jenner, he was a general practitioner, and during the ten years of his professional life practised in the country towns of Ludlow, Shiffnal, and Tenbury At the outset of his career he performed a number of experiments on puppies, mice, kittens, and rabbits, which he rendered unconscious first through partial asphyxiation by the exclusion of air, then by inhalation of carbonic acid and later of nitrous oxide During the state of 'suspended animation', as he called it, so obtained, he performed incisions, applied ligatures, amputated ears and limbs, without the animals showing any signs of pain and with good surgical results In 1824 he published a pamphlet entitled "A Letter on Suspended Anima-

tion, Containing Experiments Showing that it may be safely employed during Operations on Animals with the View of ascertaining its Probable Utility in Surgical Operations on the Human Subject" The pamphlet was addressed to T A Knight, a fellow of the Royal Society, but no reference to it has been found in the *Transactions*, and contemporary evidence shows that the method was condemned as unpractical and dangerous Having failed to obtain recognition from his own countrymen, Hickman paid a visit in 1828 to France, where he addressed a memorial to Charles X requesting permission to develop his ideas in French medical and surgical schools The request was referred to the Académie de Médecine, where it appears to have met with general derision or indifference, although the famous surgeon Baron Larrey approved of the method and even offered himself for experiment Hickman returned to England a disappointed man, and died two years later at the early age of thirty years without having brought his work beyond the experimental stage

NOTHING more seems to have been heard of Hickman's work during the seventeen years following his death, although during this period inhalation of ether and, to a less extent, of nitrous oxide became an exciting fashionable amusement like the cocktail parties of to day It was not until after the publication of the work of Crawford Long, Horace Wells, and W T Morton in the United States on anæsthesia that the valuable achievements of Hickman began to receive attention It is gratifying to learn that Hickman's labours have at last received due recognition On the initiation of the Section of Anæsthetics of the Royal Society of Medicine, a fund, which has just been closed, was started for the restoration of Hickman's grave and tombstone in the cemetery of Bromfield Church and the erection of a memorial tablet, the balance being reserved for founding a medal for research and original work in connexion with anæsthesia The tablet, which is the work of Mr Eric Gill, was unveiled in Bromfield Church by Sir St Clair Thomson, a past president of the Royal Society of Medicine, on April 5 A souvenir volume, which was presented to those attending the reception at the Wellcome Historical Museum on April 2, contains an account of Hickman's work illustrated by contemporary portraits, facsimiles of his letters and other relics of him which are now on view in the Museum

IN the *Times* of April 5 there is an account of an experiment made to find out the time required to transmit the entire front page of a Californian newspaper from San Francisco to New York It was found that it could be done in three hours, and the inference is drawn that the feat is one of great significance We are told that the transmission was by radio waves of short wave length from a facsimile transmitter and that they were received in the laboratory of the General Electric Company at Schenectady The feasibility of doing this has been known for several years, but no evidence is quoted to prove that the given transmission is at present a commercial proposition The facsimile transmission of business correspondence by radio is already in established use on the eastern side of the Atlantic A good many problems will have to be solved, however, before anyone owning a radio receiving set can have his daily newspaper delivered to him every morning by merely attaching a recording apparatus to the set It is unfair to inventors to publish statements which lead the public to jump to the conclusion that it is only necessary to make slight improvements on known methods to increase their efficiency enormously Sometimes, also through the Press not understanding the object of an experiment, quite erroneous conclusions are drawn For example, when the Marchese Marconi sent a signal from his yacht at Genoa to operate a relay which by means of local power closed the switches controlling the electric lamps lighting the Sydney Exhibition 11,000 miles away, the conclusion was drawn that the radio transmission of power 'in bulk' was at last accomplished Although the experiment was noteworthy, it proved nothing as to the commercial feasibility of transmitting power by radio

THE last few years have witnessed a remarkable revival in polar exploration Few of the expeditions have been on a large scale, most of them being confined to one or more summer seasons in the Arctic or Antarctic, but they have generally been noted for intensive investigation of particular problems The time is thus opportune for the British Polar Exhibition, which is to be held in the Central Hall, Westminster, on July 2–15 next The exhibition will illustrate the deeds of British explorers from the sixteenth to the twentieth century One section will contain a loan collection of relics, historical documents, old charts, pictures, maps, paintings, flags, and ship models Another section will deal with modern polar work, including the research into whales and whaling now being conducted in Antarctic waters A third section will illustrate equipment, food, and appliances In this section various firms have promised help Two evening lectures will be given on south polar and north polar exploration respectively A polar booklet is being prepared for sale by Dr H R Mill Any profits that accrue from the exhibition will be distributed to societies or institutions engaged in geographical research A small committee is undertaking the arrangements, and Lieut Com L C Bernacchi, Carlton Chambers, 8 Regent Street, London, S W 1, is the organising director There is little doubt that the exhibition should evoke much interest and have considerable educational value in demonstrating the aims of polar exploration

A MOVEMENT for the encouragement of gliding in Great Britain has at last been initiated by the establishment of the British Gliding Association, with Air Vice-Marshal Sir Sefton Brancker as its first president Generous gifts, both of money and of apparatus, have been received from numerous well-wishers of this branch of aeronautics Meanwhile, clubs are being started in different parts of the country, and gliding looks as if it may become a popular and at the same time scientifically valuable sport We are, indeed,

gradually becoming air minded In Germany, where this movement, owing to restrictions on the use of the power unit in machines, is undoubtedly more advanced, the Government assists by subsidy on account of the aerodynamic information that has become available by this new activity The lecture on "Ten Years Soaring and Gliding in Germany", by Prof Walter Georgii, delivered before the Royal Aeronautical Society and recently noticed in these columns, has done much to provide the necessary precise technical details for successful development here, and has undoubtedly been largely responsible for the new impetus to the movement The British Gliding Association, with its offices at 44A Dover Street, London, W 1, has produced the first number of its new journal, which contains much valuable information on the subject

Partnership between science and industry formed the theme of Mr J Arthur Reavell's presidential address to the Institution of Chemical Engineers delivered on April 4 Scientific investigation, he said, has enabled the wool industry to turn out a product of higher finish and to utilise low grade wool and waste, in agriculture it has led to increased yields and improved quality, while in the steel industry the discovery of resistant alloys has led to great economies These are examples of the way in which science has aided industry, but there is still considerable delay in translating the findings of the laboratory into industrial practice To avoid this time lag, Mr Reavell pleaded for the representation of the scientific side of industry on boards of directors It is essential in modern industry, he said, that there should be scientific men on the boards of companies in whom their non scientific colleagues have sufficient confidence to enable decisions on technical questions to be taken with less delay Industry is not entirely to blame in this matter, for, in the past, scientific workers have largely neglected the financial side of industry This attitude must be changed, for science is now and must be increasingly in the future, a fundamental part of industry At the close of the address, the following medals were presented Moulton Medal, awarded for the best paper of the year of a mature character, to Mr H Hellings, Dr S Pexton, and Dr Chaplin, Junior Moulton Medal, awarded for the best paper by a graduate or student of the Institution presented to the graduates' and students' section, to Mr Harold Smith, Osborne Reynolds Medal, for meritorious service for the advancement of the Institution during the year, to Prof J W Hinchley, honorary secretary of the Institution It is of interest to note that the Moulton awards are made for the first time

The Final Report of the Departmental Committee on Ethyl Petrol has been published by H M Stationery Office (1s net) The report embodies the results of investigations extending over eighteen months on the prevalence of the occurrence of lead in normal urine, in the settled dust of the streets and in garages, on the quantities of lead found in the crank case oil and cylinder deposits of motor vehicles run on ethyl petrol, and on the possible danger to health arising from the spillage of ethyl petrol in confined spaces and from the exhaust gas of motor vehicles run on ethyl petrol The results of these investigations agree with those of the experiments carried out in the United States of America, and show that the use of ethyl petrol as a motor fuel would not increase the proportion of particulate lead in the air of the streets to such an extent as to constitute a risk to the health of the community The results of the investigations show also that the risk of injury to health from the spillage of ethyl petrol and from the absorption of lead tetraethyl through the skin is so small as to be negligible

The recent appointment by the Prime Minister of a committee to report on the desirability of establishing one or more national parks in Great Britain gives particular interest in an article in *Geography* for March in which Dr Vaughan Cornish takes a general survey of the coasts of Great Britain from this point of view He suggests first that the choice of a coast park should not lie in Scotland, on account of the short winter days, or in eastern England, with its low winter temperatures The south coast has obvious advantages in climate and accessibility but owing to the development of seaside resorts, it is scarcely possible to find a stretch of wild cliff scenery long enough to serve the purpose of a park His suggestions, finally, are that the most suitable sites are in the two peninsulas of Pembroke and Cornwall In Pembroke he points to the stretch of wild coast line between Strumble Head and Caldy Island, and in Cornwall to the cliff scenery between Cambeak and Trevose Head on the north coast and the granite cliffs of the Land's End In the chosen areas, a mild winter climate and relatively long days would enhance the value of the scenery and render the parks more valuable

The best method of eliminating the flue dust emitted from power station and factory chimneys is one which is being actively investigated by engineers at the present time When coal is burned upon a grate, the solids which pass into suspension are produced by the mechanical action of the draught raising the finer particles of the solid fuel With pulverised fuel, on the other hand, the fuel is burned when in the gases of the furnace In this case a greater percentage of solid matter reaches the chimney It was hoped that, as the dust is exceedingly fine, it would be carried great distances before it reached the ground Experience has proved that this is not the case In a paper read before the Association of Mining Electrical Engineers by J W Gibson, and published in their *Journal* for January and February 1930, a good introduction is given to chimney dust problems Several methods have been used in practice to eliminate the dust One of the earliest methods was to reduce the velocity of the flue gases so that the dust has time to fall out of suspension Another method is to use an electric precipitator, and for light dust concentrations this method is probably the best The method of spraying the smoke with water, technically known as washing, is being actively investigated at the present

time The quantity of water required is large, and if the coal contain sulphur the water gets acidulated and recirculation increases the acid concentration The water circuit, therefore, has to be designed so that it can resist corrosion In few cases would it be permissible to permit the effluent water to flow into a stream and the commercial solution of the problem of neutralising the acid is not easy Another promising method is to cause the effluent gases to rotate so that the dust is thrown out by centrifugal action Successful attempts have been made abroad to reduce the ash content of the fuel before it passes into the combustion chamber By combining several of these methods,successful results could be obtained

AT the present time the amount of nitrate obtained by the fixation of atmospheric nitrogen in the form of ammonia is equal to about half the total world consumption It is highly probable that artificial nitrate will replace natural nitrogen products In the *Brown Boveri Review* for December, a description is given of electrical machines which are particularly suitable for use in ammonia works and have been developed to meet the severe service conditions in this industry The production of ammonia by the high pressure process is divided into three distinct operations The first consists in isolating and purifying the gases nitrogen and hydrogen The second consists in combining those gases in the presence of a catalytic agent This has to be done at the most suitable temperature and pressure for the reaction In the third operation the ammonia is concentrated and combined with some agent to form the required commercial product Usual products are ammonium sulphate, calcium nitrate, and potassium nitrate In the first operation the nitrogen is usually obtained from liquid air by fractional distillation at very low temperatures Compressors and pumps are required for this process They are usually driven by 200 kilowatt motors contained in flame proof enclosures The production of hydrogen by electrolysis of water requires a very heavy current consumption, 25,000 kilowatts sometimes being used If only three phase current is available, it has to be converted into direct current This is usually done by rotating machinery Brown Boveri and Co , however, manufacture mercury arc rectifiers for this purpose having a capacity of 3000 kilowatts For the second process they also make a steam turbine driven turbo-blower which circulates gases at a pressure of 260 kgm per sq cm

WE have received from the director a number of the recent issues of the *Publications of the Hull Museum*, dealing, for the most part, with local antiquities Of these, No 163, "Hull Museum Treasures" is a reprint of articles by Mr T Sheppard, the director, which have appeared in the *Hull Daily Mail* during the past year Week by week some specially noteworthy object in the Museum has been exhibited in a case apart and has been figured and described in the local newspaper This is a method admirably calculated to stimulate local interest in the collections which may be commended to curators of other local museums Of more general interest to archæologists are two *Publications*, Nos 162 and 166 Of these, the latter contains the speech made by Sir Frederic G Kenyon in October last in declaring open the Mortimer Collection of Prehistoric Antiquities, while the former is the catalogue of the collection The Mortimer collection of prehistoric objects, from the barrows of East Yorkshire, was made by the two brothers R and J R Mortimer, corn merchants, of Driffield, in the last century Being first in the field, they were fortunate in being able to induce farm labourers to scour the country in search of relics Prizes were offered for the greatest quantity of implements found, one of these being a free trip to the Leeds Exhibition of 1868 Later, the brothers devoted themselves to opening up the barrows of East Yorkshire They brought together a remarkable collection of prehistoric, Roman, and Saxon antiquities which was described by J R Mortimer in his "Forty Years' Researches in British and Anglo Saxon Burial Mounds"

AFTER Mr J R Mortimer's death, Driffield failed to retain the collection as he had hoped it would, and finally it was purchased for Hull by Col G H Clarke at the very low price of £1000 The collection is now exhibited in the Old Art Gallery in the City Hall as "The Mortimer Collection, the Gift of Col Clarke" British archæologists owe a deep debt of gratitude to Col Clarke and to the trustees of the Mortimer estate for having kept this important and indeed unique collection in England, as it might well have gone to the United States at a much higher price The catalogue describes the collection, item by item, under the heading of each site the mound or grave in each case being stated It is well illustrated but it lacks a map of the area, and a plan of each site is much to be desired If the catalogue attains a second edition, as a work so valuable to archæologists deserves, these defects might be remedied

A COPY reached us recently of a paper on "A National Script for India", read in May last before the East India Association, London, by Dr A Latifi, Ambala, Punjab Dr Latifi makes it quite clear that, in view of the extreme complication of the Arabic and Devanagri scripts, Roman is virtually the only competitor in the field What he does not establish so unquestionably is that Roman must undergo considerable adaptation before it meets Indian requirements His main argument is that Roman script, in its unmodified form, leads to such inconvenient orthographies as ACHCHHĀ This, he suggests, would be rendered far better by a script which distinguished between the two A sounds, had a single symbol for the sound CHH, and used the Arabic *teshdid* as a mark of repetition In such a script, the word ACHCHHĀ would become ΛƐ̃A The emendation is certainly more concise, but is it really a simplification? The proposed new symbol is not an easy one to write, nor it is easy to see why Hindustani has more need for group sound symbols than have the European languages, which have so far managed to do very well without them If repetition of syllables is a feature peculiar to Hindustani, then there is a certain case for introducing the Arabic contraction, but to

differentiate the script any further seems only to be increasing the difficulties of communication between Indians and Europeans There is a quite natural temptation on the part of reformers to bestow on India the benefits of reforms which Europe in her linguistic conservatism rejects But it must be remembered that a familiar alphabet immensely facilitates the learning of a new language, and one may well question very seriously whether it is worth sacrificing this advantage for the sake of a slightly more perfect notational system

Referring to the letter on "Curling" by Mr W H Macaulay and General G E Smith in Nature of Mar 15, p 408, Mr Wm Taylor, of Messrs Taylor, Taylor, and Hobson, Ltd, Stoughton Street Works, Leicester, writes suggesting that 'borrow' is due to the difference of friction on the two sides of the cup, in one case the sum and in the other case the difference, of rotational and translatory motions being involved This, however, could not produce any sensible effect in the first 40 yards of the run of a stone, it would have an effect only quite close to the end Mr Taylor also suggests that the friction at the back edge of the cup cannot be greater than that at the front edge, the standard law of friction on ice, however, is that it decreases with increased pressure, the thawing due to pressure providing a lubricant The greater friction behind than in front is probably partly due to the rim of the cup being sharper inside than outside

Volume 21 of the Collected Researches of the National Physical Laboratory contains 448 pages devoted to 21 papers on magnetic and electrical subjects which have been written by the staff during the last five years and have in nearly all cases been published in the proceedings of scientific societies or in the scientific or technical periodicals during that period Seven of these deal with the design and accurate testing of standard inductances or of standard resistances which are to be as free as possible of induction Many of these problems arise in connexion with telephony, and radio waves and their propagation furnish the subject of nine other papers which deal with the polarisation and attenuation of the waves, the determination of the direction from which they come and the errors which might causes in the determination The wireless valve and the piezo electric quartz resonator each get a paper devoted to them, while problems of power distribution receive attention in papers on the losses in magnetic sheet material and in dielectrics respectively Terrestrial magnetism receives consideration in a paper on a coil method of determining the vertical component, and precision is imparted to the definition of the capacitance of a condenser by an investigation of the effect of its surroundings In short, the volume represents advances to which the staff may look back with considerable pride

The Huxley Memorial Lecture for 1930 of the Imperial College of Science and Technology, South Kensington, will be delivered by Prof Graham Wallas, on "Physical and Social Science", on Monday, May 5, at 5 30 p m

At the annual general meeting of the Physical Society, held on Mar 28, the following officers were elected for the year 1930–31 —*President* Prof A. S Eddington, *Hon Secretaries* Dr Ezer Griffiths and Dr Allan Ferguson, *Hon Foreign Secretary* Prof O W Richardson, *Hon Treasurer* Mr R S Whipple, *Hon Librarian* Mr J H Brinkworth

Brigadier General Sir Harold Hartley, fellow and tutor of Balliol College, Oxford, and Mr Allen Mawer, Provost of University College, London, have been elected members of the Athenæum Club under the provisions of Rule II of the Club, which empowers the annual election by the Committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public service

The following appointments in the Colonial Agricultural and Forestry Services have recently been made Mr C K Latham, Mr A S Richardson, and Mr A J Wakefield, district agricultural officers, to be senior agricultural officers, Tanganyika Territory, Mr R B Allnutt, to be district agricultural officer, Tanganyika Territory, Mr J R P Gent, deputy conservator of forests, Gold Coast, to be deputy conservator of forests, Nigeria

A memorial service for the late George Alexander Gibson, professor of mathematics in the University of Glasgow from 1909 until 1927, was held in the University Chapel on Friday, April 4 Prof Gibson, whom failing health compelled to retire from his academic duties after a long and strenuous period of service in the Royal Technical College and the University, was greatly respected as an able and conscientious teacher, while he also rendered important services as an administrator in earlier days in the work of reorganisation at the Technical College and later on as a member of the University Court

The Royal Geographical Society will celebrate its centenary in October this year According to the provisional programme recently issued, the celebrations will begin on Oct 21 with the opening of the Society's new lecture hall and other new buildings at Kensington Gore by his Majesty the King or one of the Royal Princes appointed by him Other events will include addresses on the history of the Society, on the history of exploration during the last century, and on certain other aspects of geography There will be a reception on Oct 22 and a centenary dinner on Oct 23 A detailed programme will be issued to fellows later

An important auction sale of botanical books and books of travel will take place on Monday and Tuesday next, April 14 and 15, when Messrs Christie, Manson, and Woods will offer at 8 King Street, St James's, S W 1, the library formed by Samuel Rudge, and his nephew, Edward Rudge, author of "Plantarum Guianæ Rariorum, 1805–7", containing many rare works

In the "Report on the Health of the Army for the Year 1928" (London H M Stationery Office Price, 5s net), recently issued, Lieut General Fawcus states that the year under review was the healthiest since the War, the admission ratio having fallen to

426 2 per 1000 of the strength, or 11 5 per 1000 below that of 1913 The invaliding and constantly sick ratios also show a reduction, although both are somewhat higher than in 1913 Among the men, the four chief causes of admission to hospital are venereal diseases (7213), malaria (6550), inflammation of tonsils (6110), and inflammation of areolar tissues (5465) The enteric fevers contributed only 42 cases, a remarkable record

VOL 1, consisting of six numbers, and No 1 of vol 2 of the *Technical Instrument Bulletin*, a journal devoted to optical and allied instruments as applied to industry and research, and issued in collaboration with the Emil Busch Optical Co , have now appeared Several of the articles have dealt with photography and photographic apparatus , among others may be mentioned contributions on choice of magnification in microscopy by Prof Hauser, on optical instruments for testing works materials by H Ehlert, on instantaneous photography of living micro organisms by A G Frewin, on the meaning of apperture by Dr Hans Schulz, on microscopical examination of glass by Dr L Springer, and on the magnifying spectacle by O Heinemann Copies of the journal will be sent on application to the editor, A G Frewin Diamond House, Hatton Garden, E C 1

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —Two technical assistants, chemists, at the Royal Arsenal, Woolwich—The Chief Superintendent of Ordnance Factories, Royal Arsenal, Woolwich, S E 18 (April 14) An organiser of agricultural education for the Administrative County of West Suffolk—The Secretary of the West Suffolk Agricultural Committee, Shire Hall, Bury St Edmunds (April 19) A demonstrator in biology at Guy's Hospital Medical School—The Dean, Guy's Hospital Medical School, London Bridge, S E 1 (April 22) A research assistant in the mechanical engineering department of the University of Sheffield—The Registrar, The University, Sheffield (April 23) A temporary sanitary inspector for the Royal Borough of Kensington—The Medical Officer of Health, Town Hall, Kensington, W 8 (April 26) A lecturer in engineering at the Sunderland Technical College—The Chief Education Officer, 15 John Street, Sunderland (May 5) An assistant indexer for work in connexion with the forthcoming collective index at the Bureau of Chemical Abstracts—The Secretary, Bureau of Chemical Abstracts, Central House, Finsbury Square, E C 2 (May 9) Lecturers in pure mathematics and in geography at the L C C Shoreditch Technical Institute—The Education Officer (H2/1), The County Hall, Westminster Bridge, S E 1 (May 10) A lecturer in the Department of Phonetics at the School of Oriental Studies—The Director, School of Oriental Studies, Finsbury Circus, E C 2 (May 15) Part time lecturers in Siamese and Tibetan, respectively, at the School of Oriental Studies—The Director, School of Oriental Studies, Finsbury Circus, E C 1 (June 14) A science master, chief subject chemistry, at Bishop's Stortford College—The Head Master, Bishop's Stortford College, Herts A public analyst for the purposes of the Food and Drugs (Adulteration) Act, 1928, for the county of Southampton—The Clerk of the County Council, The Castle, Winchester

Our Astronomical Column

A New Trojan Minor Planet —*Circular* 294 of the Astronomisches Recheninstitut contains an announcement by Dr G Stracke that he has discovered a seventh Trojan planet It was found by K Reinmuth, assistant at Königstuhl Observatory, on Jan 27, and observed by him again on Feb 19 and 24 , Dr Stracke deduced the orbit from these three places,and finds the mean daily motion to be 297 852″, almost exactly that of Jupiter Both i and ϕ are moderate, being 3° 9′ and 8° 42′ respectively, so the oscillations from the equilateral position will not be so large as in some cases It makes a fifth member of the group of Trojans the longitude of which is 60° greater than that of Jupiter, while there are only two on the other side of Jupiter

The New Planet.—A circular from the Lowell Observatory, dated Mar 13, combined with several numbers of the *Daily Science News Bulletin*, issued by Science Service of Washington, D C , give details of the discovery The Lawrence Lowell photographic telescope was devoted to the search for the body, the existence of which was predicted by the late Prof Percival Lovell The work was placed in the hands of Mr Clyde W Tombaugh, a young assistant who joined the Observatory staff in January 1929 He systematically surveyed the ecliptic zone, and had nearly half completed the circle when on Jan 21 last he detected the new orb in the vicinity of Delta Geminorum The discovery was confirmed by plates taken on Jan 23 and Jan 29, and since Feb 19 the planet has been regularly followed Examination in the 24 inch refractor failed to show a definite disc , comparison of the visual with the photographic magnitudes shows that its light is yellower than that of Uranus or Neptune

Circular No 7D of the Société Astronomique de France reports that M F Baldet observed the planet visually with the 33 inch refractor at Meudon on Mar 20, 27, and 28 , he satisfied himself that the angular diameter did not exceed 0 2″, which corresponds to 4000 miles at a distance of 45 units He makes the erroneous statement that a body of diameter 1500 kilometres and albedo 0 15 would appear of magnitude 15 at distance 45 This error of taking the light as varying as the inverse square of the distance, instead of the inverse fourth power, since the distances from both sun and earth have to be considered, has been common

The *Illustrated London News* of April 5 contains excellent reproductions of five photographs of the planet, taken at Flagstaff, Yerkes, Neubabelsberg, Merate (Milan), and Oxford (Radcliffe) The Flagstaff photograph is undated, but was probably taken early on Mar 2 (U T) Measures on the photograph give the following position for the planet for the equinox of 1930 0 R A 7^h 16^m 13^s 72, N Decl 22° 5′ 18 3″ It was then 17^s east of δ Geminorum, which it passed about Mar 8 It is now again approaching the star, but owing to its northward motion it will clear it on the north side on its return journey The inclination of its orbit to the ecliptic appears to be about 14°, which helps to explain why it was not picked up sooner, as twenty years ago it was several degrees south of the ecliptic

Research Items.

Gipsy Exorcism—In Pt 3, Vol 8 of the *Journal of the Gypsy lore Society*, Ser 3, Mr Engelbert Wittich describes some of the fraudulent tricks practised by German gipsies, and includes among them two forms of exorcism—*digno dorgaben* ('little exorcism') and *baro dorgaben* ('big exorcism') By 'little exorcism' is meant the curing of illness, but 'big exorcism' is the expulsion or exorcism of an evil spirit which is bringing misfortune to the house The practice of 'little exorcism' for illness is usually left to a female gipsy The patient is given three chestnuts, of which one has previously been bored with a red hot needle These 'magic' chestnuts are said to have been obtained from a 'holy tree' in India, and must be worn by the patient next the skin for three days and three nights If at the end of that time they are split open in the presence of the gipsy, and one of them is found to have a black stain in the middle, this is a bad sign portending death This fate can only be averted by the payment of a sum of money which the gipsy spends on obtaining magic herbs and potions 'Big exorcism' comes into operation on the indication of the presence of an evil spirit by a snake's skin, the heart of a bat still fresh, or a hedgehog's foot with the bones arranged to resemble a child's hand, being found when the householder is digging in his garden The evil spirit must be made *gamlo* (kindly) Holy water must be obtained at considerable expense from a holy spring in India, known only to a limited number of the gipsy's people The whole place is then sprinkled with the water, and digging is undertaken in the garden to see if the spirit is appeased If, as is usual, another sign of misfortune appears, the *baro rom* or 'big man', that is, the wizard, or the *baro tschuwl*, the 'great woman' or witch, is called in He comes with great solemnity, accompanied by some sign, the cattle become restless, spirit candles burn with a blue flame in the garden, etc After an incantation—"Bind the straw, hang the straw, give the horses water"—the gipsy finds in one of a plate of hard boiled eggs over which he has repeated his incantation three times a curiously coiled horse hair, a presage of evil The ancestors of the victim have incurred the wrath of Heaven by a serious crime A large sum of money is buried in the garden with three hens' heads This ultimately is found to have been changed into a root curiously formed, which must be carefully tended for years until prosperity returns

Rapid Changes in Mammals caused by Climate—It is seldom that the process of change of characters comes under observation, but the history of the acclimatisation of four different species of marsupials seems to offer a case in point About 1870, the late Sir George Gray introduced several species of wallabies from Australia to Kawau Island, near Auckland, New Zealand A. S La Souef now records that the intervening sixty years have impressed themselves in quite a definite way upon the fur of the wallabies (*Australian Zoologist*, vol 6, p 111, 1930) In three species the same change is noted, that the fur is softer, more silky, and longer, and that while the colouring is darker the markings are more pronounced In only one of four species of wallabies examined was there no alteration from the normal Australian type The likelihood that the change is a result of environment is strengthened by the similarity of change shown by opossums which also have been introduced into New Zealand In these also the fur is found to be longer, more silky, and less dense, and the alteration in character is so marked that, according to the author, one has no difficulty in distinguishing New Zealand opossum pelts from among thousands that may be offered in a sale room

Food-storing by Californian Woodpeckers—The well-known studies of the acorn storing habit of the California woodpecker (*Balanosphyra formicivora*), to which Prof W E Ritter has devoted many years, have been pushed to a new stage by the author (*Quart Rev Biol*, vol 4, p 453, 1929) in his attempt to estimate the functional or evolutionary value of the habit to the birds themselves By various means he has tried to test the survival value of acorn storing, and his strong conclusion is that, although the habit shows sharp limitations to its adaptiveness, it nevertheless is distinctly to the advantage of the California woodpecker For example, a rough census of the numbers of this species in various districts shows that it exceeds its nearest competitors, the flicker and the Lewis woodpecker, in a proportion varying from three to one to five to one These others do not store food, and Ritter argues that food storing, by making the California woodpecker less dependent on local environmental conditions during severe weather, has reduced the rate of mortality and increased the numbers of birds Close study of the storing habit shows that it is no general activity but conforms minutely to varying external conditions, in fitting storage holes for acorns of different sizes, in selecting nuts of convenient size for handling, and in several other respects, all of which are intrinsic evidences of the adaptiveness of the activities On the other hand, maladaptations are manifest in the occasional storing of objects which cannot be used as food, in the storing of food where it cannot be recovered, and in the making of storing holes which are never used at all

Nematode Infection of a Young Dolphin—In an interesting address to the Quekett Microscopical Club, published in the Club's journal of December last, on the life histories of some nematodes, Dr H A Baylis refers to the group of related genera and species of nematode worms which occur only in whales, porpoises, and dolphins and are usually found in the bronchi, the air containing cavities in the head, or in the blood vessels Each species of worm seems to be strictly confined to one or two kinds of host, and in some species of Cetacea practically every individual appears to be infected Dr Baylis records a heavy infection of adult worms in a dolphin so young that its stomach was still full of its mother's milk, and points out that if the larvæ of the worm were discharged into the sea they would be unlikely to reach the proper host again He therefore suggests that pre natal infestation occurs, the worms being regularly handed on from mother to offspring As the worms are viviparous this would be possible, for larvæ would probably always be available so long as adult worms were present

Nitrogen Fixation by Bacteria—The question as to whether or not the nodule bacteria of leguminous plants can fix atmospheric nitrogen independently of their host has always been a vexed one, the results previously obtained by a large number of workers being decidedly conflicting It is, therefore, of particular interest that three papers have recently appeared on this subject within a few weeks of each other by independent workers, all of which are unanimous in their conclusion that no fixation of nitrogen occurs apart from the host plant F E

Allison (*Jour Agr Res*, **39**, p 893), working with 31 strains of legume nodule bacteria, grown in a large number of media, under a variety of conditions, has obtained consistently negative results His conclusions were based on nearly a thousand analyses determined by the Kjeldahl method E W Hopkins (*Soil Science*, **28**, p 433) gives a useful tabulated summary of all previous investigations, results and working conditions He also obtained no evidence of nitrogen fixation from any of the five hundred analyses carried out with the Davisson Parsons method M E Löhnis (*Soil Science*, **29**, p 37) has also obtained a negative answer to the question, employing in some experiments the Gunning Arnold and in others the ter Meulen micro method for the nitrogen determinations It would seem particularly convincing that all three workers have secured similar results although each used entirely different methods

Ionised Layers in the Upper Atmosphere—A report on part of the work of the Peterborough Radio Research Station of the Department of Scientific and Industrial Research has been published by Prof E V Appleton in the March number of the *Proceedings of the Royal Society* In this paper, attention has been mainly directed to variations in the equivalent height of the layers of ions responsible for the reflection of the waves used in wireless transmission, as studied by the interference fringes formed at Peterborough between waves coming directly from Teddington, Bournemouth, or Birmingham, and those coming by way of the upper air It seems now to be highly probable that the reflecting stratum is really multiple, the secondary maxima and minima which sometimes accompany and occasionally replace completely the main fringes have properties which are difficult to reconcile with the view that they always arise through multiple reflection between a single layer and the ground, but are readily accounted for in terms of a second layer at a height of approximately twice that of the main 100 km layer The properties of at least the 100 km layer are, however, in common with most atmospheric phenomena, somewhat erratic, for occasionally it will remain at about the same height during the observations, instead of rising as it usually does to some 125 km at the hour before sunrise The theory that a solar radiation is responsible for the production of the ions fits in well with most of the observations, but much still remains to be found out about the details of its action, and the nature of the ions Two further papers are to appear, on simultaneous reception at different stations, and the results obtained with waves shorter than those made use of for the work described in the present paper

Electric Power Stations in Japan—In a paper read at the World Power Conference in Japan, an abstract of which appeared in *Engineering* of Jan 31, S Fukumaka discussed the joint operation of steam and hydroelectric power stations in Japan Since 1922 electricity supply has increased very rapidly and increasing use has been made of water power The steam stations are now mainly used to supplement the water power plants at times when the load is very heavy This reduces the cost of the energy supplied to a minimum and conserves fuel Fukumaka divides the power from hydraulic plants into two parts The first is the power capacity based on the minimum flow throughout the year, and this power, which he calls primary, is continually utilised The second part consists of the excess power that can be generated during the rainy season This part can be considered primary if it can be supplemented when necessary by steam plant In order to obtain the best results, the economical problems need modification for each case The total electrical supply in Japan now exceeds three million kilowatts The peak of the seasonable load, however, occurs in winter when the water power available is least The steam plant which has to be installed to meet this shortage must be cheap It must be capable of meeting large fluctuations and the time necessary for starting it must be small In addition, the operating staff must be small and the stand by charges a minimum These requirements are influencing the design of all the new stations, with the result that the use of pulverised fuel is becoming general

Extinction of Methane Flames by Water Vapour—Some interesting experiments on the effect of water vapour on the limits of inflammability of methane in air, which supplement those made in 1926 with carbon dioxide, nitrogen, argon, and helium, are described in the February number of the *Journal of the Chemical Society* by Coward and Gleadall The extinctive action of five of the six diluent gases runs in the order of their molecular heat capacities Helium has an exceptionally high extinctive effect, ascribed to its abnormally high thermal conductivity Other factors have very little influence carbon tetrachloride, although it undergoes extensive reaction in the flame of a methane-air mixture, falls into line with the other diluent gases

Passive Copper—The results of some measurements of the adhesion of 'passive' copper are given by M Nottage in a paper in the March number of the *Proceedings of the Royal Society* The copper was made passive by first boiling in absolute alcohol, and then plunging whilst still hot into dilute nitric acid Experiments with ordinary copper and steel showed that passive copper adhered very strongly to a similar surface, the value of the adhesion with palmitic acid lubrication being 21,000 gm per sq cm, whereas ordinary copper has an adhesion of 14,200 gm per sq cm against itself The passive copper had a uniform reddish tinge, quite unlike the patchy appearance of the usual tarnished surface, and was presumed to be coated with a very thin layer of cuprous oxide, which possessed considerable permanency, persisting for example on rubbing with fine magnesia powder on silk, and on exposure to impure damp air The results of the adhesion determinations are taken to indicate that the surface film produces a decided increase in the intensity of the attraction field

Oxidation of Acetaldehyde—Although it is known that, in the oxidation of benzaldehyde by oxygen, peroxides are formed, there was no information as to the course of the oxidation of acetaldehyde, Liebig in 1835 having observed that it absorbs oxygen at the ordinary temperature, giving, according to him, acetic acid In the February number of the *Journal of the Chemical Society*, Bowen and Tietz have shown that a peroxide of acetaldehyde is quantitatively formed, that it is a moderately stable substance, and that it is produced thermally as well as photochemically when liquid acetaldehyde is shaken with oxygen There are two possible peroxides, namely, peracetic acid, CH_3 CO O OH and diacetyl peroxide, CH_3 CO O O CO CH_3, both of which have been prepared in other ways The photochemical reaction is essentially the same throughout the ultra violet absorption band of acetaldehyde, and the rate is proportional to the square root of the light intensity The formation of diacetyl peroxide occurs in the gaseous, liquid or dissolved states, but it is probably produced by secondary reaction of peracetic acid, which is assumed to be the first product in a chain reaction

The Viscosity of Liquids.

Among the properties of liquids the viscosity is probably the one the investigation of which has suffered most from lack of any accepted theory, however crude and approximate, to guide it A great body of more or less careful observations exist, but it has furnished remarkably little information as to the nature of the liquid state The new technique of X rays, the Raman effect, and the depolarisation of light may do much to elucidate the structure of liquids, but the older and grosser property of viscosity must be at least as pertinent Recently, a letter of mine published in Nature of Mar 1 upon the subject of liquid viscosity called forth a number of letters, and seemed to make it advisable to say a little more of a theory which, little elaborated as it is, offers a picture which may prove helpful The conception of a transitory and fluctuating 'crystallisation' of a liquid seems to fit in with other observations I am far from being satisfied with the theory as it stands my hopes go no further than that the facts cited in my present letter may suggest to some that there is a germ of truth in the point of view put forward At any rate, I intend to make some measurements myself of the temperature coefficient of liquid viscosity, in the hope that they may throw some light on the old problem as to the force exerted on a single molecule by the molecules in its immediate neighbourhood, within the Lorentz sphere

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The letter of Prof Andrade in Nature of Mar 1 raises the interesting question as to the reason for the decrease in viscosity of a liquid with rise of temperature This seems to be closely connected with the similar decrease in the frictional resistance due to the motion of solid bodies through liquids I have been lately carrying out some experiments on this latter subject as follows

Two rings of thin sheet brass were cut off a drawn brass telescope tube about 2 inches in diameter One ring was 1 inch deep and the other 0 25 inch deep These rings could be suspended one at a time by four very fine wires with their axes vertical from the bottom of a cylindric inertia mass, which last was hung by a single steel torsion wire The arrangement was such that the thin rings could be set oscillating in a liquid successively, with the rings totally immersed in it, but the inertia mass not immersed The object of using rings of different depths was to eliminate any energy loss due to wave or eddy current making due to the fine suspending wires or edges of the rings The measurement consisted in displacing the suspended mass through a certain angle, say 120°, and then noting the time required for this angle of maximum displacement to be reduced to 60° for the two rings This gives by difference a measure of the frictional resistance per unit of surface If the frictional resistance were exactly proportional to the velocity then the differential equation for the motion would be

$$I\frac{d^2\theta}{dt^2}+R\frac{d\theta}{dt}+C\theta=0,$$

where I is the moment of inertia of the oscillating mass and C the coefficient of restoration and θ the angle of displacement If t' is the time required to decrease the initial amplitude of displacement to half its value, then it is easy to show that $R=1\ 38I/t'$

On making the measurements in tap water at various temperatures the following results were found

15° C	$R=19\ 75$	60° C	$R'=10\ 1$
30°	15 2	70°	10 7
50°	12 1	80°	10 6

It is seen that a rise of temperature of the water from 15° C to 80° C reduces the frictional coefficient R to about half its value

This method is sufficiently sensitive to show the difference between fresh water and sea water at the same temperature

If we ask the reasons for it the following suggest themselves The cause of friction between a solid and a liquid may be regarded as of the same nature as the reason for the coherence of molecules together to form either a solid or a liquid In view of the assumed electric structure of atoms, this coherence must be regarded as due to electrical attractions between atoms or molecules Rise of temperature ionises or dissociates molecules into ions or atoms and promotes mobility of these with respect to the mass of the liquid Hence follows a reduction of the force required to shear a liquid surface along a solid

Experiments made with paraffin oil (Royal Daylight) showed that, although this liquid seems more limpid than water, the coefficient of frictional resistance with the brass rings was considerably greater The oil is, however, a good dielectric and therefore not ionised so much as tap water at the same temperature The practical result is that if the sea had an average temperature of 80° C instead of about 15° C, ships would require less power to drive them through the water than at present I am continuing these experiments as time permits

Ambrose Fleming

Manor Road, Sidmouth,
Mar 1

I have read with great interest Prof Andrade's letter in Nature of Mar 1, dealing with the temperature variation of the viscosity of liquids The theoretical side of this question has admittedly been curiously neglected with perhaps one or two exceptions, of which one of the earliest was Maxwell Considering, however, how generally the idea of a time of relaxation has entered into modern molecular theory, particularly in relation to liquids, it is more than probable that Maxwell's original conception of the viscosity process will receive an elaborated physical interpretation

In view of this fact I should like to mention a formula connecting the viscosity and temperature in liquids which I have had occasion to examine in a paper which has been communicated elsewhere, and which may be built up from Maxwell's fundamental definition of liquid viscosity This formula

$$\eta=\frac{Ae^{\beta T}}{T-b}$$

holds for a number of liquids over a wide temperature range, which liquids include both normal and associating liquids The accompanying table shows two examples The formula has admittedly three constants but is similar to that of Prof Andrade in that it contains an exponential function From general molecular theory and in view of the direct relation between viscosity and vapour pressure, it is probable that an exponential form of equation

for viscosity and temperature will prove to be the most satisfactory In this connexion a comparison of the derivations of J S Dunn's equation (*Trans*

Temp	Water, $A = 1\,522.$, $\beta = -0\,003822$, $b = 243$		Octane, $A = 1\,128$, $\beta = -0\,002399$, $b = 190$	
	η obs	η calc	η obs	η calc
0° C	0 01792	0 01787	0 007060	0 007060
10	01308	01289	006159	006152
20	01005	00996	005419	005423
30	00801	00797	004828	004826
40	00656	00657	004328	004328
50	00549	00554	003907	003908
60	00469	00474	003551	003548
70	00406	00410	003241	003238
80	00357	00359	002971	002967
90	00317	00317	002730	002730
100	00284	00281	002520	002519
110	—	—	002335	002332
120	—	—	002160	002165

The values for η obs for water are those of Bingham and Jackson, for octane those of Thorpe and Rodger

Farad Soc, **22**, pp 401 405, 1926) $1/\eta = Ae^{Q/RT}$ based on kinetic theory considerations and $\eta = Ae^{b/T}$ put forward by Prof Andrade should be of great interest

E W MADGE

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A SATISFACTORY explanation of the decrease of liquid viscosity with temperature has long been required, and Prof Andrade's theoretical treatment of the subject will be awaited with interest His simple formula connecting viscosity and temperature appears to give good agreement for certain liquids, but I should like to point out that it does not give such good agreement when applied to measurements on some mineral oils, as does a formula due to Slotte The measurements were taken several years ago and in attempting to find an empirical relationship between the viscosity and the temperature, I obtained, quite independently, a formula which was identical

Temp	η calc (Andr)	η obs	η calc (Slotte)
20	12 36	15 20	15 46
25	9 03	10·15	10·19
30	6 67	7 04	6 99
35	4 97	4 97	4 93
40	3 75	3 58	3 58
45	2 85	2 67	2 66
50	2 18	2 00	2 01
55	1 685	1 550	1 558
60	1 313	1 232	1 217
65	1 028	0 965	0 966
70	0·813	0·780	0 777
75	0 646	0·633	0·636
80	0 517	0·517	0 522
85	0·417	0·432	0·435
90	0 337	0 362	0·363
95	0·275	0·306	0·305

with that due to Slotte and adopted by Thorpe and Rodger as best representing their experimental results This formula is usually written in the form

$$\eta = \frac{c}{t + a}n$$

where η is the viscosity, t the temperature in °C, and C, a and n constants depending on the liquid used The constants A and b in Prof Andrade's formula (NATURE, Mar 1, p 309) have been calculated for a somewhat viscous oil from the viscosity values at 35° C and 80° C, and the agreement between the observed results and those calculated from the two formulæ shown in the accompanying table

One naturally expects to be able to obtain closer agreement between observed and calculated results with a formula containing three constants than with one containing two, but in this connexion a further interesting fact was observed It was found that the value of C obtained from eight oils of widely varying viscosities could be expressed with considerable accuracy by the formula

$$C = ad^n$$

where a and d are constants which are independent of the nature of the oil and the approximate values of which were $1\,5 \times 10^{3}$ and 400 respectively Thus Slotte's formula also becomes one in which there are only two constants the values of which are dependent on the nature of the liquid On examining the values of C and n obtained for other liquids it was found that, with the exception of the alcohols, they were connected by a similar relationship, the values of a and d differing but slightly from those obtained for the mineral oils This empirical relationship was not published, and it was thought that the results might be of some interest when considering the theoretical aspects of the problem

D H BLACK

International Telephone and Telegraph
Laboratories, Incorporated,
The Hyde, Hendon

IN a recent issue of NATURE (Mar 1, p 309) Prof Andrade publishes the following formula, $\eta = Ae^{b/T}$, for the coefficient of viscosity of liquids as a function of the temperature T, which he shows to be in excellent agreement with the experimental data Now I wish to point out that a practically equivalent formula, namely, $\eta = CTe^{U/kT}$, was given by me more than four years ago in a paper on the heat motion of solid and liquid bodies (*Zeit f Phys*, **35**, p 664 667, 1926) Since this has obviously remained unnoticed, it may be well to state briefly the fundamental conception on the heat motion of liquids upon which the above formula is based

The 'crawling' of the particles of the liquid is considered as a combination of oscillations about a (temporary) position of equilibrium and of a jerky displacement of this position from time to time The average number of oscillations performed about the same equilibrium position is equal to $e^{U/kT}$, where u is the energy required to tear the particle out of it An elementary displacement of the equilibrium position is consequently achieved in a time $\tau = \tau_0 e^{U/kT}$, τ_0 being the period of the oscillations, which corresponds to a 'crawling' velocity $v = \frac{\delta}{\tau} = \frac{\delta}{\tau_0}e^{-U/kT}$, where δ, the average range of this displacement, is of the order of the mean distance between neighbouring particles, and to a diffusion coefficient $D = \frac{1}{3}\delta v = \frac{\delta^2}{3\tau_0}e^{-U/kT}$ Now the latter is connected with the friction coefficient f(= ratio of force to the mean velocity which is due to it) by Einstein's formula $Df = kT$ If, on the other hand, we regard the particle as a small sphere of radius $a \cong \delta$ then we have by Stokes's formula $f = 6\pi a\eta$ Hence $\eta = \frac{\tau_0 kT}{2\pi a\delta^2}e^{U/kT}$ which is the above formula with $C = \frac{\tau_0 k}{2\pi a\delta^2}$,

Putting here $\tau_0 \cong 10^{-13}$ sec and $a \cong \delta \cong 10^{-8}$ cm one gets for C or Andrade's coefficient $A = CT$ values of the correct order of magnitude.

J. Frenkel.

Physico Technical Röntgen Institute,
Leningrad, Mar. 8.

I am naturally gratified at the interest which my brief letter on liquid viscosity, published in Nature of Mar. 1, seems to have aroused. In view of the correspondence which has ensued I should like first to indicate briefly the theoretical considerations, mentioned in passing in my former letter, which lead me to the formula $\eta = Ae^{b/T}$, secondly, to refer to the general directions in which I look for experimental confirmation, and thirdly, to discuss some of the points raised by the correspondence.

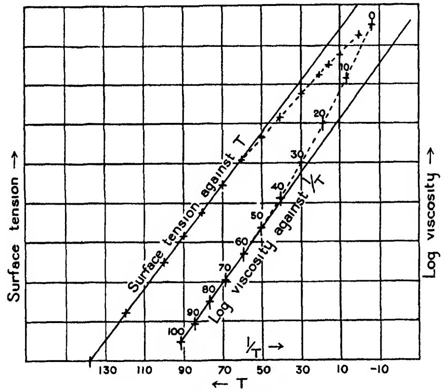

Fig. 1.

The method by which I arrive at the formula is by taking two layers of molecules, parallel to the direction of motion of the liquid and considering the transfer of momentum between them. In the case of a gas, Maxwell showed how the viscosity can be derived by considering this momentum as being communicated by molecules transferring themselves bodily through a distance large compared to their own sizes, from one layer to the other. But both the non-fulfilment of the conditions postulated in Maxwell's treatment, and the fact that while gas viscosity goes up with temperature liquid viscosity goes down, show that some radically different picture is needed for liquids. I suppose that momentum is transferred from layer to layer by a temporary union of molecules in contiguous layers, the duration of this union not exceeding the very brief time required for the molecules to acquire a common velocity of translation. The union takes place under the action of the residual field of the molecules, which suffices to bind them permanently in the solid state, but is overcome by the energy of motion in the liquid state. General considerations suffice to show that the greater the temperature agitation the smaller the probability that the residual field of fixed average strength will result in temporary union for a given molecule. The viscosity of a liquid, therefore, decreases with rise in temperature until finally the energy of motion overcomes the molecular field and the liquid boils. The general picture is one of the liquid 'crystallising' temporarily in minute patches; at the temperature of solidification the crystallisation becomes general and permanent, at the boiling point it must be very small.

To obtain the quantitative law more precise assumptions are necessary. We can suppose that the temporary combination represents the position of minimum potential energy of the molecule with respect to the local field. Just as in Langevin's theory of magnetism the tendency of the molecules to set, with respect to an *external* field, in the position of minimum potential energy, with axes parallel to the field, is opposed by the thermal agitation, so here too the tendency of two molecules to combine is opposed by the thermal agitation. The simplest application of Boltzmann's formula leads to the viscosity formula given in my former letter. In this formula the constant b is, of course, of the form $-E/k$, where E is the energy, numerically negative, of juxtaposition, k the Boltzmann constant. The constant A contains as factors $M^{2/3}\rho^{-1/3}$, where M is the molecular weight, ρ the density. The formula virtually assumes that the number of impacts is independent of the temperature, the effect of the increased velocity being opposed by certain factors, such as the expansion. It is probable that A depends slightly on the temperature, and I am now trying to elaborate this point, but comparison with the recorded data shows that A may be taken as a constant to a first approximation.

It is my belief that the constant b, expressing in some way the strength of the intermolecular field, will prove of great importance for the theory of liquids, and will take its place alongside the surface tension. The constant b can be accurately determined from the variation of viscosity with temperature, the constant A less so, it being very insensitive, like the constant A in O. W. Richardson's thermionic formula.

One way in which to check the reasonableness of the hypothesis on which the theory is based is to calculate the number of momentary combinations which it requires to give the observed viscosity. Just above the

melting point I suppose that practically every collision leads to a sharing of momentum, so that the number obtained should be of the order of the total number of collisions In the case of mercury this number comes out to be 3 7 × 10[12] per sec , which is reasonable, being of the same order as the vibration frequency of the solid I have also obtained a rough value for the internal pressures of one or two organic liquids, which come out to be of the right order, but the assumptions made in this case are of a tentative nature, and I am now devoting further attention to this problem

I distinguish between true association, as occurring in liquids ordinarily called associated, and the brief union needed for the sharing of momentum which I postulate for all liquids True association, in which molecules are bound together in clusters of two or more for a time large compared to the intervals between collisions, leads, with the mechanism postulated, to an increase of viscosity The application of the formula to many associated liquids leads to some very interesting results It is found to hold accurately at higher temperatures, but as the temperature falls the actual viscosity becomes increasingly greater, compared to that predicted by the formula This I take to mean that at the higher temperatures the liquids are either not associated at all, or else that such association as may exist is of a stable kind, unaffected by the temperature In the case of water the formula $\eta = Ae^{b/T}$ expresses the viscosity within 0 5 per cent from 100° to 60°, when the deviation begins to set in and rapidly increases It is striking that the surface tension of water is a linear function of the absolute temperature above 60°, but that below 60° the deviation from linearity rapidly increases, as shown by Fig 1, in which surface tension plotted against T, and the logarithm of viscosity plotted against $1/T$, are exhibited in the same diagram As an inverse temperature scale would make it troublesome to trace the point at which the viscosity law changes, the actual temperature values of the different points are indicated on the curve itself Water and many other associating liquids can be fitted by the formula $\eta = A'e^{b/T-\theta}$ as an approximation, the formula having no detailed theoretical basis, but being derived by an obvious analogy from other branches of physics For water the fit is within about 1 per cent throughout the range It seems more reasonable, however, to use a formula of the type $\eta = A(1 + \alpha e^{-\beta T})e^{b/T}$, the term $1 + \alpha e^{-\beta T}$ expressing the decrease of association with temperature This formula, it is true, has four constants, but four constants are commonly used in empirical formulæ designed to fit water[1] It gives the viscosity over the range $T = 263$ 7 (supercooling of 9° C) to $T = 363$ within 0 25 per cent (the viscosity at 100° seems experimentally doubtful) The variations in the viscosity of water, as measured by different observers of high repute, markedly exceed this at many temperatures There is no indication of a systematic deviation For fitting the formula I have taken the mean of the results of Hosking, and of Bingham and White, as given in Landolt Bornstein, 1923 edition, for which the greatest variation at any one temperature is 0 9 per cent, while at most temperatures the agreement is good For supercooled water the values of White and Twining, quoted in Landolt Bornstein, are taken

The accompanying table exhibits the fit

If b measures the strength of the molecular field, as defined by the conditions specified, it should be connected on one hand with the boiling point, and on the other hand with the dielectric polarisation due to deformation of the molecule In all homologous series for which measurements are accessible to me, b increases regularly with the boiling point and with the polarisation This is an aspect of the subject at which I am now working with some promise of result Among other results obtained by considering the variation of b throughout homologous series, I may mention that plotted against numbers of carbon atoms for the fatty acids, b lies on one curve for the odd numbers of carbons, and another for the even numbers The data are very scanty, but this conclusion seems justified, and extends to the liquid state conclusions based on the behaviour of the solid state to X rays

The variation of viscosity with pressure is another part of the subject which is yielding promising results The general nature of the increase is clearly represented by the theory, log η being a linear function of P as a first approximation, but even in cases such as water something of a more quantitative nature has already been obtained The viscosity of solutions is another field to which the general formula is being applied

One of the greatest troubles which I have met with in trying to check the theory is the lack of precise data Organic chemists tell me that it is doubtful, for example, if the fatty acids used for the recorded determinations were pure Again, the variations between the results obtained by different observers with certain of the most ordinary substances, for example, ethyl ether or mercury, are very large for ether they amount to as much as 9 per cent in the neighbourhood of 20° C , and for mercury to 3 per cent at temperatures above 140° C (see Erk, "Unsere Kenntnis der Zähigkeit von Quecksilber," *Zeitschrift für Physik*, 47, 886 , 1928) The range of measurements

VISCOSITY OF WATER

$$\eta_{calc} = 4\ 328e^{1554/T}(1 + e^{12\ 097 - \ 0477T}) \times 10^{-5}$$

Temperature C	$\eta_{obs} \times 10^5$	$\eta_{calc} \times 10^5$	$\frac{\eta_{obs} - \eta_{calc}}{100\ \eta}$ (Percentage error)
− 9 3	2545	2539	+ 2
− 8 48	2454	2456	− 1
− 7 23	2337	2338	− 05
− 6 2	2246	2246	0
− 4 7	2118	2122	− 2
− 2 1	1927	1930	− 2
0	1795	1792	+ 2
5	1523	1521	+ 1
10	1306	1308	− 15
15	1140	1139	+ 1
20	1003	1003	0
25	894	892	+ 2
30	800	800	0
35	723	722	+ 15
40	657	657	0
45	600	600	0
50	550	551	− 2
55	508	508	0
60	471	471	0
65	436	437	− 2
70	407	407	0
75	380	381	− 3
80	356	356	0
85	335	335	0
90	315	315	0
95	(297)	296	− 3
100	(281)	280	− 35

In the experimental values for 95° and 100° Hosking's values, which are markedly higher than those of other observers, are omitted The values given are averages for Slotte, Thorpe and Rodger, and Bingham and White Accurate determinations in the neighbourhood of the boiling point are badly needed

[1] The purely empirical four constant formula which Bingham and Jackson (Bureau of Standards, No 298) give for fitting water from 0° to 100° shows an error of 1 4 per cent when extrapolated to − 9° C

is, in general, extraordinarily limited compared to, say, that available for surface tension there are, in general, no measurements above the boiling point at atmospheric pressure, and for low boiling liquids scarcely any at all below 0° C, which is in many cases, for example, pentane, the most important part of the range I am planning a series of investigations to be carried out in this laboratory, in the hope of adding to the reliable data for viscosity, more especially the temperature variation required to give b

Turning to the letters which have been sent to NATURE since my first letter was printed, the letter from my old friend Dr S E Sheppard, published on Mar 29, gives what is practically my formula and states one of my first results, namely, that for a large number of liquids the formula represents the observed data, within experimental error, over a wide range of temperature The complete independence of our work—our letters were written within a few days of one another, his in America, mine in England—may serve to emphasise the point that I wish to stress, namely, that this formula has a fundamental significance, and the constant b—Sheppard's k—has an intimate relation to the various properties connected with the internal energy of liquids The other points of interest which Sheppard raises are not the same as mine Sheppard has not made it quite clear how he obtains his a for associating liquids, for $\eta = Ae^{b/T}$ will not fit, for example, water Presumably, he has found the value of b by fitting one or two of the low temperature values I note that he has found that the formula has been already given by Senor J de Guzman in the *Anales de la Sociedad Española de Física y Química*, 1913 Prof Kendall has pointed out to me that he mentions it, in the form log $\eta^{1/8} = a/T + b$, in a footnote to a paper in the *Journal of the American Chemical Society*, 39, 1799, 1917 I have also, since deriving it, found that J S Dunn has given it in a short paper in the *Transactions of the Faraday Society*, 22, 401, 1926, as quoted in Mr E W Madge's letter Mr Dunn's paper had escaped my attention just as it has that of Dr Sheppard and his collaborators No particular attention ever seems to have been paid to the formula before, and it is not quoted in the standard books, for example, Hatschek's "Viscosity of Liquids" It is always distressing to find that one has been anticipated, in whatever degree, but it certainly does not seem to have been previously realised that the formula $\eta = Ae^{b/T}$ is fundamentally characteristic of normal liquids

As regards Mr E W Madge's formula, $\eta = \frac{A}{T-b}e^{\beta T}$, it does not seem to fit octane sensibly better than my formula with two constants, and it does not fit water so well as the formula $\eta = Ae^{b/T-\theta}$, with the same number of constants, which I quote earlier in this letter, variations as large as 1 5 per cent occurring in Mr Madge's table, as against 0 9 per cent over the same range with my simpler three constant formula If Mr Madge had computed the value for supercooled water at − 9 3° C, he would have found a discrepancy of nearly 5 per cent, as against 1 3 per cent given by $\eta = Ae^{b/T-\theta}$

Dr Frenkel's formula is scarcely, as he claims, "practically equivalent" to mine, for it is $ATe^{b/T}$, instead of $Ae^{b/T}$, and the multiplication by T renders it unable to fit the variation of viscosity with temperature, interesting as is its derivation

I am afraid I can attach but little importance to the fact, cited by Dr Black, that the formula does not fit commercial mineral oils, of no definite composition, in view of my success, confirmed by Dr Sheppard, in fitting a great variety of pure chemical substances I have investigated the type of variation from the formula shown by Dr Black's oils, and it is of a nature quite different from that shown by pure substances which do not fit, namely, such as associate strongly So far as I can learn, oils of this type often change their viscosity permanently on heating

Sir Ambrose Fleming's very interesting letter deals with the points which lie somewhat off the main current of my argument

I feel that some apology for the length of this letter is needed, but, even in this space, I have only been able to refer in the briefest possible manner to points connected with the subject which I have under immediate investigation

E N DA C ANDRADE

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Catalytic Reactions at High Pressures

THE technical synthesis of ammonia by high pressure catalysis has given a great impetus to the development of high pressure reactions At the present time reaction pressures are confined to a few hundred atmospheres, at which pressures the technical problems in so far as material and construction are concerned may be fairly claimed to be solved Work in the high pressure laboratory at Amsterdam envisages operating pressures above ten thousand atmospheres and a few determinations of physical constants have already been made at pressures as high as 35,000 atmospheres At these pressures, again, especially at high temperatures, new problems of material, construction, and design will confront the engineer hoping to industrialise a process operating under these conditions Technical interest in catalysis at high pressures is at present focused on the numerous reactions involving the use of water gas as raw material and on hydrogenation of coal, including products derived from coal Many others involving processes of amination and oxidation are doubtless capable of development

Whilst the difficulties involved in the hydrogenation of coal are partly economic in character and lie partly in the variability of the raw material, these factors are not so important in many of the reactions involving water gas, and in that field it is clear that a whole series of careful physical chemical investigations are necessary before the state of affairs may be considered to be at all satisfactory

In developing the synthesis of ammonia, preliminary work involved the determination of the data necessary to establish the conditions of equilibrium of the system

$$N_2 + 3H_2 \rightleftarrows 2NH_3$$

over a wide range of pressure and of temperature This phase of the problem was in part simplified by the absence of other reactions in the combination of the two gases and by a knowledge, with fairly accurate data available, of the specific heats of hydrogen and nitrogen and approximate values for the heat of formation of ammonia, its specific heat and compressibility More accurate data have only recently been obtained, but the approximate data available before development of the industrial processes were sufficiently accurate

In the case of reactions involving water gas, the state of affairs is much more complex because there is a whole series of reactions which are possible with the gases carbon monoxide and hydrogen The initial

reactions which are important may be formulated as follows

$$(1)\ CO + H_2 \rightleftarrows HCHO$$
$$(2)\ CO + 2H_2 \rightleftarrows CH_3OH$$
$$(3)\ CO + 3H_2 \rightleftarrows CH_4 + H_2O$$

By aldol condensation together with stages of hydrogenation a whole sequence of higher aldehydes and alcohols may be obtained from (1), with the possible exception of ethyl alcohol

Accurate data on the heats of these reactions, on the specific heats and on the compressibilities of most of the products, are at present not available and in consequence the equilibrium under high pressures and over a range of temperatures for any one of these reactions cannot as yet be said to be determined with any degree of accuracy The work at the Imperial College on the experimental determination of the methanol equilibrium, reaction (2), appears to be the most complete at the present time Having obtained preliminary if not exact information on the conditions of equilibrium, the next stage involves the choice of a suitable catalyst, and here we note that apart from chemical reactivity the catalyst employed must possess the additional property of being highly selective in its action Whilst it is known from investigations that a copper catalyst favours reaction (1), a zinc oxide catalyst containing certain promoters, for example, chromium oxide, favours (2), and an active nickel catalyst is most suitable for the formation of methane, and that the rate of aldol condensation resulting in the formation of higher alcohols can readily be augmented by the addition of small qualities of alkali, the mechanism of the catalytic processes themselves which must contain the secret of the selectivity of these catalysts is unknown

Although the use of iron as a catalyst in the synthesis of ammonia has been known for nearly thirty years, it is only recently that any definite ideas as to what constitutes an active catalyst for this reaction have been developed These may be said to have originated in an examination of the activity of catalysts prepared by two different ways, as minute agglomerates and crystals formed as a result of condensation from the vapour phase, and by the breaking up of large crystals by processes of ' activation ' and prevention of the regrowth of the grain size by the addition of suitable materials

Developments along similar lines involving measurements both on the heats of adsorption as well as reaction rates in both forward and reverse directions may assist in the building up of a satisfactory interpretation of catalytic action From the discussion which was held at the Royal Society on Mar 20 on catalytic chemical reactions under high pressures, it was clearly evident that work both scientific and industrial in this important field is advancing rapidly in England, and in addition that the organic chemistry of the simpler aliphatic compounds was a field which requires immediate exploration by both physicists and physical chemists ERIC K RIDEAL

Historic Natural Events

April 14, 1912 S S *Titanic* sunk by Iceberg in Atlantic —During the months of April and May 1912, there was an abnormally large amount of ice off the Newfoundland Banks In April no fewer than 395 icebergs were counted south of lat 48° N, compared with an average number of 83, and in May 345 compared with an average of 130 The icebergs spread far to the south of their usual limits, and on April 14, the White Star liner *Titanic* struck one in lat 41° 46′ N, long 50° 14′ W, and sank with great loss of life As a result of this disaster, the first International Conference for Safety of Life at Sea was held in London in 1913, at which it was decided to establish and maintain a regular patrol of the iceberg area

April 15, 1077 End of ' Canossa ' Winter —The winter of 1076–77 was so rigorous in England, France, and central Europe that the oldest inhabitants did not remember a similar one The " Harleian Miscellany " records that " in the tenth year of his William the Conqueror's] reign, the cold of winter was exceeding memorable, both for sharpness and for continuance, for the earth remained hard from the beginning of November until the midst of April then ensuing " In Europe the snow lasted from Nov 1 to Mar 26, and the Rhine was crossed on the ice so late as April In central France hard frosts continued for four and a half months and the vines perished The passes across the Apennines were completely blocked by snow and ice It was from Jan 25 to 28, 1077, that the Emperor Henry IV of Germany stood shivering, bare headed and barefooted, and clad in a hair shirt, before Pope Gregory VII in the courtyard of the Castle of Canossa in northern Italy, before the Pope removed the ban of excommunication imposed for his harsh treatment of the Saxon princes

April 15, 1927 Mississippi Floods —The floods in the Mississippi valley in February–July 1927, because of their magnitude, protracted duration, and economic destructiveness, formed one of the greatest calamities of modern times Their beginnings may be traced back to the abnormal rains of September 1926 over the greater part of the Mississippi drainage area There were further heavy rains in October and November, and in December there were general floods in the southern streams tributary to the Ohio River The early months of 1927 also had a rainfall above the normal in most parts of the basin, but the most serious flooding did not begin until April 15, 1927, when a crevasse began to form in the levee guarding the river at Dorena, Mo, 30 miles below Cairo, Ill From that date the floods spread with terrible rapidity, and crevasses were formed in the levees The total area of lands overflowed was 28,573 square miles, and the damage was estimated as more than 284 million dollars The loss of life was 214, this (as well as the material loss) would have been far higher but for the warnings issued by the U S Weather Bureau

April 18, 1850 Tornado at Dublin —A violent thunderstorm developed at 3 30 P M, with hailstones as large as pigeon's eggs At 4 P M a tornado passed over, with hurricane winds from south east, which abruptly changed to north west A great deal of damage was done, in some districts practically every pane of glass was blown in, chimneys were overthrown, and roofs carried off, while many trees were uprooted. These fell to north west and south east in about equal proportions, adjacent trees sometimes lying in opposite directions The Cattle Show was in progress, and the cattle broke loose, leading to fearful confusion

April 18, 1906 Earthquake in California —The Californian earthquake on this day caused much damage in San Francisco, less by the shock than by the fires that followed it The most remarkable feature of this earthquake was the great length (not less than 270 miles) of an old fault known as the San Andreas rift along which the displacement occurred, reaching from Cape Mendocino on the north to near Monterey on the south Subsequent surveys of the district showed that the crust on both sides of the fault had moved, that on the south west side to the north west and on the other side to the south east

April 19, 1849 Snowstorm —There was heavy snow in south east England on April 16–20, and on April 19 the Westerham coach was buried and left all night in a snow drift on Titsey Hill

Societies and Academies.

Paris

Academy of Sciences, Mar 3 —**Emile Borel** Probabilities universally negligible —**L Lecornu** The loss of heat in explosion motors —**A Cotton** and **G Dupouy**: The magnetic fields given by the large Bellevue electro-magnet Diagrams are given of the results of the exploration of the magnetic fields produced under varying conditions of radius of the pole pieces, and distance between them For very small pole pieces and at a distance apart of 2 mm, the field is near 70,000 gauss —**Charles Moureu, Charles Dufraisse**, and **Nicolas Drisch** Researches on the mechanism of the formation of rubrene a new synthesis The starting point of this synthesis is the ketone $(C_6H_5)_2C=CH-CO-C_6H_5$ Treatment with phosphorus pentachloride and the resulting chlorine derivative allowed to react with potassium acetate gives a substance capable of conversion into rubrene by simple heating The yield is 30 per cent of the original ketone, and the new synthesis has nothing in common with the older methods of preparation —**J Costantin** Mountain plants and Lamarckism A discussion of the resistance to disease in the sugar cane acquired by growth at high altitudes and its transmission —**E L Bouvier** Some observations on the Saturnioid butterflies of the family of the Ceratocampidæ —**V Grignard** and **Th N Iliesco** The condensation of isobutanal A résumé of work published in detail elsewhere —**Raffaele Nasini** was elected a *Correspondant* for the Section of Chemistry —**Bertrand Gambier** Some properties of circles —**A Buhl** The cartography, in E_3, of triple integrals with fields deformed in E_4 —**A Marchaud** A characteristic topological property of Jordan curves without a double point —**Georges Durand** Ordinary points and singular points of envelopes of spheres —**Henri Poncin** A mixed problem in a circular ring —**Julius Wolff** The angular derivative in conformal representation —**J Haag** The theory of the rachet pins —**A Gruvel** and **W Besnard** Description and presentation of a new oceanographic apparatus The instrument is designed to collect a specimen of water, to measure the temperature at a predetermined depth, and to measure the depth at which these operations are carried out —**Georges Déjardin** The second spectrum of xenon in the interval 9000 A –6000 A The lines given were obtained by using the oscillating discharge in a tube without electrodes —**V Ambarzumian** and **D Iwanenko** Unobservable electrons and the β rays An outline of a theory of β rays analogous with the theory of light quanta proposed by Dirac —**Estanave** A new contribution to integral photography —**F Bourion** and **E Rouyer** The cryoscopic study of paraldehyde in aqueous solution, and in solutions of potassium chloride —**Alfred Molnar** Researches on the cold hardening of lead, tin, and cadmium at different temperatures —**Marcel Guillot** The carrying down of polonium, a chloropoloniate, by ammonium chloroplumbate The precipitation of crystals of $(NH_4)_2PbCl_6$ from a solution containing polonium results in partition of the polonium between the liquid and crystal phases Since, under the same conditions of acidity, the precipitation of lead chloride from a solution containing polonium leaves the whole of the latter in solution, it is concluded that the phenomenon is probably not due to adsorption but to the formation of a polonium compound $(NH_4)_2PoCl_6$, isomorphous with the lead chloroplumbate —**C Matveyeff** The cone in-cone structure observed in the celestine of Wereino (Ural) —**Philippe Fabre** The laws of electrical excitability by very short discharges in rapid muscles —**C Ninni** The demonstration of the existence of the tubercle ultra-virus by direct inoculation in the lymphatic ganglions

Leningrad

Academy of Sciences (*Comptes Rendus*, No 21, 1929) —**V Ambarzumian** Methods of determining the number of different atoms in the atmosphere of stars —**D I Eropkin** Determination of the absorption in the atmosphere of planets A new method is described which is based on the study of the influence of the atmosphere on the gradual decrease of the brightness of a satellite in the half shadow and in the shadow of the planet The method requires that the entire photometric curve of an eclipse should be interpreted, and it can be applied in practice only to the case of planets with bright satellites, for example, the earth and Jupiter —**V V Barovskii** A description of a new species of the genus *Malthodes* Kies (Coleoptera, Cantharididæ) of Central Asia *Malthodes grigorievi* sp n is described from Fergana, this is the first representative of the genus in the fauna of Central Asia —**N Olenev** Classification and geographical distribution of Ixodidæ (4) Descriptions of *Ixodes semenovi*, sp n from *Accentor collaris* (Scop) in Turkestan, and of *I redikorzevi lagurae* sbsp n, from *Lagurus lagurus* in the Lower Volga steppes, as well as a discussion of several other species —**N P Annenkova** A supplement to the polychæt fauna of the Black Sea (1) *Goniada bobrezkii* sp n This is the first representative of the family Goniadidæ known from the Black Sea

(*Comptes Rendus*, No 22, 1929) —**D I Mushketov** and **P M Nikiforov** A gravimetric and seismic expedition to Central Asia A preliminary account of the expedition is given The work with pendulums, gravity variometers, and seismographs was carried out at a number of points in the Fergana depression, and a lack of compensation was quite definitely established, the resulting tendency of the earth's crust to vertical upward displacements is the cause of earthquakes, which are not unusual in that locality As regards the origin of the Fergana depression, the conclusion was reached that it was formed as a result of squeezing of the earth's crust, the sial masses having been pressed into a denser layer underlying the crust —**P I Simanin** Contributions to the Culicid fauna of Fergana A list of twelve species of mosquitoes is given The number of setæ on the first joint of the valva is a doubtful specific character in the genus *Anopheles* —**D Beliankin** Titanium oxide in the dinas In a metallurgical oven, the titanium oxide of a dinas brick migrates towards the unaffected zone Analogous phenomena can be observed in the natural granites and porphyrites

Prague

Czech (Bohemian) Academy of Sciences and Arts (Second Class, Natural Science and Medicine), Dec 6 —Extraordinary meeting Prof J Matiegka gave a detailed account of his investigation concerning the identification of the remains of Jan Amos Komenský (Comenius) in the Church of Naarden, Holland —Ordinary meeting—**O Jirovec** The fauna of the digestive tract of the termite *Calotermes* species Greek —**O Jirovec** Nuclear division in *Trypanosoma evansi* —**C Čechura** Magnetic declination of Moravia and Silesia in the epoch 1925 5 —**V Špaček** and **B Zahálka**: Magnetism of the mountain Rip —**F Němejc** Palæobotanical researches on the quaternary flora of some localities in the vicinity of Růžomberk, Slovakia —**M Dillinger** A study of the maximum of current

occurring in the electrolysis of mercuric cyanide solutions with the dropping mercury kathode The electro-reduction of the non electrolyte mercuric cyanide in presence of electrolytes proceeds like that of oxygen, the maximal maximum occurring at a certain conductance, which is proportional to the concentration of mercuric cyanide The mercury cathode shows a considerable polarisation —**B Brauner** Comments to a former report on the analysis of water from the pond Babylon, Bohemian Forest

Rome

Royal National Academy of the Lincei, Nov 17 — **P Burgatti** The transformations of Lorentz A simple method is given for deducing Cayley's theorem, that the coefficients of a linear and orthogonal transformation in a Euclidean S_n are expressible rationally by means of $n(n-1)/2$ independent parameters —**U Cisotti** Types of rigid isolated profiles subjected to dynamic action by means of a local fluid current circulating round them —**N Parravano** and **E Onorata** 'Blanc' alumina Results are given which indicate the existence of what, in Wyckoff's terminology, must be regarded as a semi crystalline alumina, obtained by the thermal decomposition of hexa hydrated aluminium chloride, as well as of another alumina arising from the first at a higher temperature The former exhibits the double refraction characteristic of non monometric crystalline substances, whereas the second gives a distinct X ray interference spectrum pointing to hexagonal or rhombohedric symmetry The passage from the first to the second is accompanied by increase in density from 2 2 to about 3 5 and is, therefore, attended by approach of the atoms in the space intervening between the atoms of the unit cell Conversion of the second form into corundum also occurs with rise in the density (from 3 5 to 3 9) and with further approach of the atoms of the unit cell —**F Vercelli** The system of currents in the Straits of Bab el Mandeb in the summer —**E Bortolotti** Geodetic co ordinates along a line (1) —**R Calapso** A problem of the zero system osculatory to a congruence W —**Gr C Moisil** Movable datums in functional space —**O Onicescu** The asymptotic behaviour and the zeros of a class of entire functions —**G Supino** A criterion of choice between elastic solutions with equal resultants —**G Viola** The system of U Cephei The data collected on this system since 1913, particularly by Bemporad, are considered The mean light curve indicates asymmetry with respect to the minimum epoch, oscillations both during the phase of totality and at the beginning and end of the eclipse, and inconstancy of the maximum luminosity of the system —**E Fermi** The $4d$ complex of the helium molecule —**Giambattista Dal Piaz** New geological observations on the region lying between the Aurino torrent and the river Rienza (Upper Adige) (3) —**A Ferrari** and **F Giorgi** Crystalline structure of anhydrous iodides of divalent metals (1) Cobalt, ferrous, and manganese iodides These iodides exhibit structure of the cadmium iodide type The elementary cells have the following dimensions: cobalt iodide, $a=3\ 96$ A, $c=6\ 65$ A, $c\ a=1\ 68$, density, 5 75, ferrous iodide, $a=4\ 04$ A, $c=6\ 75$ A, $c\ a=1\ 67$, density, 5 39, manganese iodide, $a=4\ 16$ A, $c=6\ 82$ A, $c\ a=1\ 64$, density, 5 01 The dimensions of the unit cell of lead iodide, for which previous authors have given discordant values, are $a=4\ 53$ A, $c=6\ 92$ A, $c\ a=1\ 53$ —**L Maddalena** Utilisation of an interesting hydric level over the north east part of the plateau of Sette Comuni —**G Gabrieli** Two iconographic codices of plants in miniature, in the Royal Library at Windsor.

Official Publications Received

British

Report of the Rugby School Natural History Society for the Year 1929 (Sixty third Issue) Pp 43+2 plates (Rugby)

Canada. Department of Mines Geological Survey, Canada. Memoir 155 Horton Windsor District, Nova Scotia. By W A Bell (No 2176) Pp. ii+268 (86 plates). (Ottawa F A Acland) 50 cents

Canada Department of Mines National Museum of Canada. Bulletin No 62 Annual Report for 1928 Pp 88 (Ottawa F A Acland)

Dominion of Canada Report of the Department of Mines for the Fiscal Year ending March 31, 1929 (No 2217) Pp. vi+58 (Ottawa F A Acland) 25 cents

Gold Coast Survey Department Records Vol. 1 Report on Three Chains of Triangulation surveyed in the Southern Part of the Colony during the Years 1924, 1925 and 1926 By Capt. J Calder Wood Pp 116 (London The Crown Agents for the Colonies, Accra Survey Department) 12s 6d

Proceedings of the Royal Society of Edinburgh. Vol 50, Part 1 No. 4 The Occurrence of Cell Division in the Endodermis By George Bond Pp 38 50 1s Vol 50 Part 1, No 5 The Early Colonization of North eastern Scotland By Prof V G Childe Pp 51 78+2 plates 3s Vol 50 Part 1 No 6 The Gonadotrope Actions of the Anterior Lobe of the Pituitary By B P Wiesner and F A. E Crew Pp 79 103+2 plates 3s Vol 50, Part 1, No 7 On the Presence of a Kyogenic Substance in the Mouse Placenta By Ljuba Mirskaia Pp 104 112+1 plate 1s (Edinburgh Robert Grant and Son, London Williams and Norgate, Ltd)

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Navy (Health). Statistical Report of the Health of the Navy for the Year 1928 Pp 151 (London H M Stationery Office) 5s net

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Department of Scientific and Industrial Research Building Science Abstracts Vol 3 (New Series), No 2 February Abstracts Nos 242 247 Pp 37 71 (London H M Stationery Office) 9d net

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A Check List of the Sphegidae of the Ethiopian Region By Dr G Arnold Pp 21 (Pretoria The Transvaal Museum)

Foreign

Det Kongelige Departement for Handel, Sjøfart, Industri, Håndverk og Fiskeri Norges Svalbard og Ishavs Undersøkelser Skrifter om Svalbard og Ishavet. Nr 27 Beiträge zur Kenntnis der Invertebraten Fauna von Svalbard Von Sig Thor Mit Beiträgen von F Lengersdorf A. C Oudemans, C Fr Roewer und A Roman Pp x+156+26 Tafeln 18 00 kr Nr 28 Die Altersstellung des Fischhorizontes, des Grippianiveaus und des unteren Saurierhorizontes in Spitsbergen Von Hans Frebold Pp. 36+6 Tafeln 4 00 kr (Oslo Jacob Dybwad)

Proceedings of the United States National Museum Vol 76, Art. 22 Mitrospira, a new Ordovician Gasteropod Genus By Edwin Kirk (No 2819) Pp 6+3 plates 5 cents. Vol 76, Art 23 A new Fossil Coral from the Cretaceous of Texas By J Edward Hoffmeister (No 2820) Pp 3+2 plates (Washington, D C Government Printing Office)

U S Department of Commerce Bureau of Standards. Bureau of Standards Journal of Research Vol 4, No 1, January Pp ii+175 (Washington, D C Government Printing Office)

United States Department of the Interior Office of Education Bulletin, 1929, No. 34 Statistics of City School Systems, 1927-1928 Pp 198 30 cents Bulletin, 1929, No 35 Statistics of Public High Schools, 1927-1928 Pp 136 20 cents. (Washington D C Government Printing Office)

Japanese Journal of Astronomy and Geophysics Transactions and Abstracts Vol 7, No 2. Pp. ii+47 81+ii 18 (Tokyo National Research Council of Japan)

Smithsonian Institution United States National Museum Contributions from the United States National Herbarium Vol 26, Part 4 The Piperaceae of Costa Rica. By William Trelease Pp v+115 226+vii xii. (Washington, D C Government Printing Office) 20 cents.
Smithsonian Institution United States National Museum. Bulletin 148 Collections of Objects of Religious Ceremonial in the United States National Museum By Immanuel Moses Casanowicz. Pp viii+207+75 plates 90 cents. Bulletin 151 East African Reptiles and Amphibians in the United States National Museum By Arthur Loveridge. Pp v+135 25 cents. (Washington, D C Government Printing Office)
Publikationer fra det Danske Meteorologiske Institut Aarbøger Isforholdene i de Arktiske Have (The State of the Ice in the Arctic Seas) 1929 Prepared by Comdr C I H Speerschneider Pp 20+5 maps (København G E.C Gad)
U S. Department of Agriculture Farmers Bulletin No 1488 Control of Insect Pests in Stored Grain By E A Back and R. T Cotton Pp. ii+30. (Washington D C Government Printing Office) 10 cents
The Peking Society of Natural History Bulletin, Vol 4, Part 2 Yenching Science Conference Papers Pp 102 (Peking The China Booksellers.) 1 50 dollars
Proceedings of the Academy of Natural Sciences of Philadelphia, Vol 81 Notes on Percoid and related Fishes By Henry W Fowler Pp 633-657 Young Stages of *Conus adversarius* Conrad By Burnett Smith Pp. 659 666 (Philadelphia.)
Transactions of the San Diego Society of Natural History Vol 6, No 1 An Annotated List of the Butterflies of San Diego County By William S Wright Pp. 40 40 cents. Vol 6, No 2 Tertiary Foraminifera from Humboldt County California a Preliminary Survey of the Fauna. By Joseph A. Cushman and Roscoe E and Katherine C Stewart. Pp. 41 94+8 plates. 60 cents. Vol 6 No 3 New and renamed Subspecies of *Crotalus confluentus* Say with Remarks on related Species By Laurence M Klauber Pp 95 144+plates 9 12 50 cents (San Diego Calif)
Ministry of Agriculture Egypt Technical and Scientific Service Bulletin No 91 The Soils of the Libyan Oases By Dr R. R Le P Worsley Pp 27+5 plates (Cairo Government Publications Office) 5 P T

CATALOGUES, ETC

Patents and Trade Marks including some Useful Information on Designs and Copyright By Benj T King Pp 28 (London Kings Patent Agency, Ltd)
Surplus Stock (List No 101G) Pp 12 Museum Jars Specimen Tubes and Microscopical Sundries (Pamphlet No 708B) Pp 12 (London A Gallenkamp and Co , Ltd)

Diary of Societies

FRIDAY, April 11

Royal Astronomical Society, at 5 —R. O Redman The Galactic Rotation Effect in Late Type Stars
Physical Society (at Imperial College of Science), at 5 —Prof P Debye The Scattering of X Rays in Gases in Relation to Molecular Structure (Guthrie Lecture)
British Institute of Radiology (Medical Meeting), at 5 —Discussion on Radiology in Bone Tumours.
Royal Society of Medicine (Clinical Section) at 5 30
Malacological Society of London (at Linnean Society), at 6 —D F W Baden Powell Notes on Raised Beach Mollusca from the Isle of Portland —J R le B Tomlin Note on *Panopea cancellata* Sow —R Winckworth Description of a new *Chiton* from Karachi
Institution of Electrical Engineers (London Students Section) at 6.15 —Col Sir T F Purves Address
Institution of Chemical Engineers (at Municipal College of Technology, Manchester), at 7 —Dr W H. Hatfield The Fabrication of Acid resisting Steel Plant (Lecture).
Society of Dyers and Colourists (Manchester Section) (at Manchester), at 7 —C Hollins Patent Law and the Dyer
Oil and Colour Chemists Association (Manchester Section) (Annual Meeting) (at Old Rectory Club, Manchester), at 7
Junior Institution of Engineers, at 7 30 —W T Dunn Gas in Japan and the Far East.
Institute of Metals (Sheffield Local Section) (Annual General Meeting) (at Sheffield University), at 7 30.—F Russell Refractories and their Uses
Oil and Colour Chemists Association (at 30 Russell Square), at 7 30 —E Hatschek Some Properties of Jellies.
Society of Chemical Industry (Chemical Engineering Group) (at Chemical Society), at 8 —Discussion on Asphalt as a Chemical Engineering Material —A W Attwooll The Principles of Manufacture of Mastic Asphalt.—D McDonald Experience with Some Applications of Mastic Asphalt in a Chemical Works.
Royal Society of Medicine (Electro-Therapeutics Section), at 8 30 —Dr H A. Bulman, Dr L H Clark, Dr S. Russ, and Dr S. Wright The Physiological Effects of Penetrating X Rays upon the Cat and Rabbit.
Society of Dyers and Colourists (Manchester Section) (at Manchester). —Dr J L. Hankey Some Remarks on the Treatment of Aniline Black subsequent to Ageing
Paper Makers Association (Technical Section, London Division) (at Connaught Rooms, Great Queen Street) —J Strachan The Relationship Existing between the Tensile Strength and the Bursting Strength of Paper

SATURDAY April 12

Physiological Society (in Department of Physiology, University, Louvain), at 10 A M —G Debois : Glycogen Recovery after Mammalian Muscular Activity as an Insulin Function —C Heymans and J J Bouckaert Sinus Caroticus Reflexes upon Venous Pressure, Liver Volume, and Heart Volume.—P Rylandt Conduction in Mammalian Auricles.—J Morelle Calcium Shifting Experimental Rickets —J P Bouckaert, J L Petit, and J de Blende Variations in Muscular Viscosity —J P Host and H Ernould On the Nervous Control of Insulin Secretion.—P de Nayer Glycogen Deposition in Rabbit s Muscles —L. de Borggraef Ions and Excitability —E J Bigwood Chemical Properties of Gelatin Jellies. — Thomas The Nature of Blood Sugar —T Lewis Reaction of the Human Skin to Cold —Prof A. V Hill The Osmotic Pressure of Muscles —Dr W Cramer On Inhibition of the Adrenal Gland and Vitamin B Deficiency —Dr J F Fulton, Dr E G T Liddell, and D McI Rioch The Influence of Experimental Lesions of the Spinal Cord upon the Knee jerk and Crossed Extensor Reflexes —E W H Cruickshank An Adjustable Automatic Shaker for Gas Analysis —*Demonstrations* —F Malengreau Micromethod for Estimation of Bismuth in Biological Material —J Rutten Isoelectric Point of Bence Jones Protein —J Morelle Calcium Shifting Experimental Rickets —J P Bouckaert Determination of Muscular Viscosity — A. K M Noyons Differential Calorimeter

MONDAY, April 14

Royal Society of Medicine (United Services Section) (Annual General Meeting) at 4 30 —Surg Capt L M Morris Recruiting—A Review of Modern Requirements
Institution of Electrical Engineers (Informal Meeting) at 7 —A. B Eason and others Discussion on Telephone Exchange Practice in Germany and Scandinavia.
Institution of Electrical Engineers (Mersey and North Wales—Liverpool—Centre) (at Liverpool University) at 7 —Annual General Meeting
Institution of Electrical Engineers (North Eastern Centre) (at Armstrong College Newcastle upon Tyne) at 7 —Annual General Meeting
Institution of Electrical Engineers (South Midland Centre) (at Birmingham University), at 7
Institution of Electrical Engineers (Western Centre) (at Cheltenham) —Lt. Col S E Monkhouse and L C Grant The Heating of Buildings Electrically by means of Thermal Storage
Institute of Brewing (London Section) (at Charing Cross Hotel).—Discussion on The Brewing, Bottling and Pasteurisation of Beers
Royal Irish Academy (Dublin)

TUESDAY, April 15

Royal Society of Medicine at 5 30 —General Meeting
Zoological Society of London, at 5 30 —F J Lambert Animal Life in the Marsh Ditches of the Thames Estuary —Prof F Werner Indian Mantids or Praying Insects —W N F Woodland On the Genus *Polypocephalus* Braun, 1879 (Cestoda).—Major E E Austen On a New Dipterous Parasite (Family Calliphoridæ, Subfamily Calliphorinæ) of the Indian Elephant, with Notes on other Dipterous Parasites of Elephants
London Natural History Society (at Winchester House E C), at 6 30 —R. Palmer Some Aquatic Insects (Becot Memorial Meeting)
Institution of Electrical Engineers (North Midland Centre) (at Hotel Metropole, Leeds) at 7 —Annual General Meeting

WEDNESDAY, April 16

Royal Meteorological Society, at 5 —Dr S K Banerji The Electric Field of Overhead Thunderclouds —Dr F J W Whipple The Great Siberian Meteor and the Waves Seismic and Aerial which it Produced
Royal Statistical Society (at Royal Society of Arts), at 5 15
Institution of Civil Engineers (Students Meeting), at 6 30 —P A. Scott Weymouth Bincleaves Firing Station, Repairing and Strengthening of Reinforced-Concrete Pier
Institution of Electrical Engineers (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7 30 —H S Carnegie The Selection of Electric Drive for Heavy Industrial Use
Folk Lore Society (at University College), at 8 —Dr R Flower The Ring of Sovereignty a Study in the Transmission of a Theme
Royal Microscopical Society at 8 —A Craig Bennett An Imbedding Apparatus for Research Workers —J Smiles The Measurement of Spherical Aberration in High Numerical Aperture Objectives by Interferometry

THURSDAY, April 17

Institution of Electrical Engineers (Hampshire Sub Centre) (at Municipal College, Portsmouth) at 7 30 —Dr C V Drysdale Alternating Current Potentiometers and their Applications.
Institution of Electrical Engineers (Irish Centre—Dublin) (at Trinity College, Dublin), at 7 45

ANNUAL MEETING

April 9, 10, and 11

Institution of Naval Architects (at Royal Society of Arts).

Friday, April 11 at 11 A M —R. Sulzer Causes and Prevention of Vibration in Motor Ships.
Dr J L. Taylor Vibration of Ships
Lieut.-Col F Dondona Sea Trials of Italian Flotilla Leaders
At 8 —G S Baker and Miss E M Keary Experiments on the Resistance and Form of Towed Barges
W C S Wigley Ship Wave Resistance—Some Further Comparisons of Mathematical Theory and Experiment Result

CONGRESS.

April 25 to 28.

Flemish Congress of Natural Sciences and Medicine (at Antwerp).

SATURDAY, APRIL 19, 1930

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No. 3155, Vol 125]

Pipe Lines and Progress

SLOWLY but surely the day of the individual, of the private firm, and of the small community is passing or has already passed The individual has parted with his liberties to the community, rationalisation is putting the private firm out of business, whilst the small town must participate in larger schemes if it is to supply such public utilities as water, gas, and electricity at satisfactory prices Thus we have a scheme for the national supply of electricity from super power stations already in being, and there is much talk of the long distance transmission of gas by trunk lines These would in the first place serve to interconnect all the existing gas producers in a given area of country, with the result that in time the main load would be supplied from the more economical plants, the others serving as a standby for conditions of peak load At the same time, the available productive capacity of the whole area would be greater than before, without any additional capital expenditure being required for new plant beyond that of the cost of the trunk lines All these considerations and advantages closely parallel those which it is hoped to attain in the electrical industry

It is surprising that a small country like Britain, in which distances are relatively so short, has not taken the lead in these matters it affords yet another proof, if such be required, of the inborn nature of British individuality The passage of our kin across the Atlantic, coupled more likely with the necessity for the co operative spirit in the development of the vast areas of a new and virgin country, has had the effect of making them super enthusiastic in developing large projects, and the very existence of distances has been seemingly accepted as a challenge to bridge and to make them as naught

The newest example of this spirit is exemplified in what is happening in regard to natural gas, which, though it can alas have no parallel in Great Britain, is well worth attention and study The great American oil industry to day has a capital of two thousand million pounds It has constructed in the United States some 100,000 miles of pipe line for the gathering and conveyance of the oil from the fields to the refineries and to the coast, the said lines contain at all times a quantity of oil estimated at 18 million barrels of 42 gallons each, they involve a very large annual expense for their maintenance and repair

At first the natural hydrocarbon gas produced

at the wells was largely wasted part of it was burnt near at hand as a source of heat part of it converted by processes which are none too efficient into carbon black which is an important ingredient of the rubber tyre

When the advantages of the gas as an industrial fuel became realised distance was regarded as no objection in running a pipe line to bring it to a potential large consumer Already some 60 000 miles of pipe line for natural gas are in existence and a very extensive programme of new construction is in hand The existing state of affairs is well shown in a large map of the natural gas pipe lines of the United States which is published by and can be obtained from the Department of Commerce

As showing the magnitude of the engineering problem involved and incidentally its beneficial effect on the steel industry it may be mentioned that in the line from Northern Louisiana to St Louis a total of 526 miles of 20 in and 22 in high pressure pipe were laid involving a weight of 115 000 tons of steel Much greater lengths than this are projected and natural gas is already beginning to reach the holders and distribution mains of the gas companies in the large cities of the Fast The natural gas has a calorific value of some 1000 B T U or roughly twice as high as that normally distributed by the gas industry problems therefore arise in regard to its dilution if it is to be burned efficiently in the existing domestic apparatus

It is claimed that already 75 per cent of the total gas burned in America is natural gas Questions naturally arise as to the permanence of any one source of supply as the wells become exhausted and the economic wisdom of the large capital sunk in the construction of the pipe it is the custom to write these off very rapidly The optimism of the American rises superior to any question of exhaustion—at the worst gas made from coal at super gas works astride the collieries can be pumped in the reverse direction through the mains is his answer

Indeed in the case of oil reversing the pipe line flow has already begun The original Pennsylvania field is largely exhausted so that the oil formerly sent from it by pipe line to be refined on the eastern seaboard has been replaced in the coast refinery by oil brought in from the Pacific Coast or Gulf of Mexico by ship such oil is being sent back along the pipe to be refined at Pittsburg and elsewhere Much more startling is the innovation to send finished petrol or gasoline as the Americans call it along a 371 mile pipe from the coast to Western Pennsylvania it is said that this will cost some 35 to 50 per cent less than the usual transport in tank waggons by rail

Naturally all sorts of problems have arisen in connexion with pipe lines the solution of which has been due to prompt and whole hearted co operation with scientific workers Soil corrosion is a most important matter even the aeroplane has been brought in to assist in making the first survey for the path of the line through rough country But for the production of better pipe and the development of welding methods which enable higher pressures to be used the transport of the natural gas such distances would not have been possible

The natural gas is obviously of very little value at the well so that its cost delivered into the holder of a city gas company even after full allowance has been made for the cost of pumping and the depreciation of the pipe is less than that at which gas of equivalent heating value can be manufactured from coal at the gas works This is of no disadvantage to the gas companies the co operation of which is essential to the success of any scheme for the introduction of natural gas seeing that one of the main items in the cost of gas to the actual consumer is that of the distribution from the point of manufacture

The lower the price at which gas can be supplied the more chance there is of its universal adoption as a source of heat its use whether by the house holder or in industry saves the worry connected with the purchase and storage of fuel to say nothing of the labour of stoking and the removal of clinker and ashes Most beneficial of all to the community will be the freedom from smoke in the cities

In Britain this last factor should appeal to us most of all but we have no natural gas and must therefore search in what other ways the price of the therm can be reduced There is every indication that the desirability of this is realised by the gas industry which apart from technical progress in the manufacture of gas in horizontal and vertical retorts is studying the use of gas from coke ovens from low temperature carbonisation and from oil refineries and cracking plants It would take us too far now to deal with the somewhat vexed question of the production of oil from coal in Britain—it has been achieved technically on the large scale though perhaps still a problem from the economic point of view Scotch shale cannel coal and the like will all eventually give their quota of oil and gas

On the continent of Europe the supply of gas

in bulk from coke oven plants in the Ruhr district over considerable distances has already made much headway, though it is understood that the original schemes to take gas as far as Berlin have been deferred Plans are also on foot to bring coke oven gas into Paris from a considerable distance

The problem in Britain is not altogether so simple as might appear The question of the cost of wayleaves for pipes and the assessment of these for rates by rural districts impose burdens which the consumer should not be asked to sustain if the nation has the production of cheap fuel and the lowering of costs in industry really at heart The proposal to locate super gas stations at the colliery also requires very careful examination, not every seam is suitable for gas making, whilst the ready marketing and cheap transport of the subsidiary products of the industry to the small consumer are factors of paramount importance

An Everflowing Stream

The Danube in Prehistory By Prof V Gordon Childe Pp xx + 479 + 57 plates (Oxford Clarendon Press, London Oxford University Press, 1929) 42s net

A BOOK of this kind has been long needed As Prof Childe notes in his preface, British archæologists, in addition to their own local antiquities, have found in the first cultures of the Mediterranean and the Near East happy hunting grounds and rich rewards There are historical reasons for that, and also for the comparative neglect of Central and even of Northen Europe Yet readers of Schliemann's works must have been impressed with the great mass of detailed work which had been done in these regions fifty years ago, however little they may have been convinced by his comparisons of this material with his own finds at Troy It must be admitted, however, that until recently the very abundance and perplexing variety of the data retarded the appearance of any such compendious handbook as Peet's "Stone and Bronze Ages in Italy" Even Hoernes' "Urgeschichte der bildenden Kunst in Europa", before its recent transformation by his pupil Menghin, was essentially a history of art (and particularly of iconic art), not of civilisation Latterly, the marked growth of popular interest in 'origins', as well as the necessity for some clue to such a labyrinth, even for specialists, has elicited summaries like Schuchhardt's "Alt-Europa", Tyler's "New Stone Age in Europe", and Prof Childe's own "Dawn of European Civilisation" But in so far as these attempted to cover the ground of Europe, and not stray far beyond it, they necessarily lacked scientific and historical, as well as literary unity What "The Danube in Prehistory" gives us is a series of intimate studies of a family, instead of a snapshot at a crowd The great valley now is no longer a corridor but a portrait gallery

Prof Childe is well equipped for his adventure His intimate acquaintance with museum collections and recent field work all over Europe, his command of the rather numerous languages in which the literature is scattered, and his previous surveys of the ground in his "Dawn" (already mentioned) and his "Aryans", give him advantages which he has here used to the full Above all, bulky as this book is, he has managed not to say too much, his characterisations of each phase of culture are graphic, and detach the really significant features from the bewildering details, and the comparisons, and inferences as to their meaning, which he has drawn, are so concisely stated, that it is only when one begins to know the book well that one discovers how much has been put into it

Very properly, an attempt to rationalise a microcosm of this sort, begins with a profession of faith, and there are few, if any, shorter and weightier statements of an antiquary's creed and code than the preface here Properly also, wild Nature frames the pageant of man's achievement the physique, and the principal external relations of the Danube basin with adjacent regions It would not have occupied more than a few additional pages, to indicate, still more concisely, what lies beyond the watersheds, even without anticipating by more than a phrase the peculiarities of the human contributions of each to Danubian cultures Without this, the significance of successive references to horse-bones, for example, will not be obvious to everyone

On the difficult problems of historical climate, and the sequence of plant regimes, what is said is cautious and trustworthy, but it would have been helpful to emphasise the contrasts between forest-regimes north and south of the valley, and still more between the vegetations that replace them respectively when drought sets in Beside the conspicuous contrast between superincumbent loess and older components of the structure, the petrological differences between different strata may seem slight, but there are phrases here and there which show that the author is aware of the marked peculiarities of 'karst' country, and the prevalence of this and other soluble rocks might have been

indicated, as well as the profound results of this, in the distribution of the types of plant covering already mentioned It is difficult, for example, to believe that the passes between Morava and Ægean were so long and so completely closed to mankind, as is represented here and hereafter, in view of the predominance of limestone country there, and this hypothesis is fundamental to the view taken in Chap iii of the course of the propagators of the culture known as 'Vinča I'

So little has been observed, hitherto, of the traces of palæolithic man in the Danube valley, that even the data collected in Chap ii (the extent of which will be a surprise to many) do not justify more than the most general inferences It is clear, however, that there was rather early admixture of brachycephalic types (p 14), so far back as Aurignacian deposits, and that consequently "the round heads of Ofnet do not necessarily betoken a fresh racial intrusion" (p 18) But in view of the general distribution of brachycephaly in Eurasia, Central European examples of it are surely intrusive, not aboriginal, whatever their date On the affinities of the long headed stock which seems to pre dominate on the loess land in early neolithic times, Prof Childe expresses no opinion, after recording several (p 45) His presentations of other folk's views are throughout commendably objective Only occasionally, even in descriptions, does a word of regret escape him, for example (p 58), on the French reluctance to take potsherds seriously, and (pp 166, 169) on delays in publication

The first neolithic culture, represented by the lower levels of the great *tell* at Vinča, has admittedly well marked resemblances with that of Anatolia Is it not, however, necessary to distinguish between neolithic Crete, for example, and the mainland sites, in view of Cretan and even Cycladic resemblances with early Sicily, Malta, and even Sardinia, and of the Egyptian glimpses of an indigenous neolithic culture in Libya Are 'East Mediterranean' and 'Anatolian' really convertible terms? Or is a good deal of the similarity among local cultures around the Ægean due to interpenetration of two distinct archetypes, one (in broad terms) indigenous to the north east, the other to the south-west, of a line from Alexandria to Rhodes? How that line is to be prolonged beyond the latter is gradually being revealed by recent work in Lesbos, in Macedonia, and south of the Corinthian Isthmus, and conclusions here may confirm or modify our interpretation of the course of events north of the Ægean

If Prof Childe is right in supposing that those who introduced 'Vinča I' culture into the Middle Danube came up the waterway, he may have to face the question whether such navigators came only from the Marmara shores, or from ports farther south To derive 'Vinča I' from fisher folk does less than justice to its emphatically agricultural character Whether the overland routes from the Marmara to the Middle Danube were really so impassable has been already doubted, and only further exploration in Thrace and Bulgaria can decide this point It must be admitted, however, that, on present evidence, early settlements seem to spread *up* the Morava, rather than downstream Jablanica—excavated too early to be quoted with confidence—seems to belong essentially to 'Vinča II', but it is noted (p 68) that Vinča itself may have remained conservative But on p 67 the possibility is after all admitted, that the beginnings of 'Danubian Ia' culture—more distant still to the north west—may be due to immigrants through Serbia, and the clay women nursing infants, in Danubian II, are "taken over from Thessaly and the Ægean" (p 70)

In the two 'Danubian' phases, outstanding controversies are as to the relations of 'Danubian I' with neighbouring cultures to the north west, in the Rhine valley and beyond, and of 'Danubian II' with the nascent civilisations of the Ægean, and especially of Thessaly The rich but inaccessible material from Butmir is put in a new perspective, as the work of an 'industrial centre', 'quite eccentric', and not 'originative', though it ran its own idiosyncrasies rather hard The recent Sumerian evidence for very early spirals in the south-east is naturally emphasised, yet it looks as if spirals, which originate in several ways, may also have originated in several places but Asia Minor is still almost unexplored, for early cultures

On the eastern margin of the 'Danubian' culture-areas lie the secluded 'painted-ware' settlements around Erösd with their perplexing resemblances to those of Ukraine, Bukowina, and Thessaly, and their 'poor cousins' injected into 'Danubian' surroundings so far off as the upper Tisza, on the frontier of Slovakia Here Prof Childe elaborates his earlier suggestion that these 'painted wares' are due to emissaries of the 'painted ware' culture of Sumeria But "frankly, many steps have to be interpolated", even if the queer "incineration necropolis" at Surghal in Babylonia be as closely like the *ploshchadki* sites of Kiev (which are neither cemeteries nor incinerated) as has been stated Once again, Asia Minor is unexplored, there have been surface-finds of early painted ware, but

Hissarlik eschewed painted ornament, and in Cyprus it is quite secondary On the other hand, the 'painted-ware' regime at its widest included Baluchistan and Mongolia, as Sir Aurel Stein and Dr Andersen have found, and the lower Volga is almost as unexplored as the Halys Meanwhile, is it certain that (p 110) 'Minyan ware' occurs at Cucuteni? One swallow does not make a summer, nor are all smooth iron-grey potsherds 'Minyan'

A whole group of intrusive cultures along the north side of the Danube basin owes its common characters to the interpenetration of two extraneous elements, the 'megalithic' culture of the Atlantic and Baltic frontage, and the pastoral regime of the 'battle axe folk' generally now derived from the Russian steppe As these cultures belong to the 'sub boreal' climatic phase, their spread was rapid, for the forests were now discontinuous, and grazing ground extensive Among the numerous controversies, Prof Childe picks his way discreetly, clarifying and supplementing he has coined one term, 'Danordic' (for cultures superimposed by Nordic intruders on Danubian aboriginals), which is likely to persist, and he offers one ingenious suggestion that the 'globular amphora' folk navigated the north German rivers, and in this way travelled far without losing characteristic 'megalithic' traits

These are only illustrations, all from the first half of this important book, of the kind of problem which the subject matter presents, and the lines on which a solution is attempted The author's candour and open mind are illustrated by his criticism of his own earlier views about the 'Pile dwellers' (p 171) Naturally many difficulties have to be confessed and left unsurmounted, until fresh evidence comes—a conspicuous example is in the chapter on the 'Corded ware' people—but those who have most to contribute will be the last to complain of that frankness, and the systematic arrangement, and clear distinction between facts and theories, secure to the book a permanent place, as a ground plan on which to lay out one's own superstructure, as time goes on We could have wished for even more illustrations, and especially for more of the quite excellent line drawings pot-fabrics are very hard to photograph, and impossible to represent fairly except by a series of examples And how comfortable it is to have all the line drawings from the same competent hand, whatever their ultimate source! The correlation diagram facing p. 418 looks like a cross word puzzle, but is easier to read when you know how The maps, though uniform in principle, and in the picturesque style of execution which finds favour now with the Clarendon Press, are not all equally eloquent, partly because some include too many kinds of data, partly because the symbols are not sufficiently contrasted But "The Danube in Prehistory" is a masterpiece in this kind of work J L M

A Chemical Dictionary

A Chemical Dictionary containing the Words generally used in Chemistry, and many of the Terms used in the related Sciences of Physics, Astrophysics, Mineralogy, Pharmacy, and Biology, with their Pronunciations, based on recent Chemical Literature By Prof Ingo W D Hackh Pp viii + 790 (London J and A Churchill, Philadelphia P Blakiston's Son and Co, Inc, 1930) 42*s*

THE present day intensely rapid development in all branches of natural science necessarily involves a growing terminology with which even the specialists find difficulties in keeping pace Particularly is this the case in chemistry, the encyclopædic nature of which scarcely needs remarking Apart from its laws and theories, chemistry has to deal with the elements, naturally occurring compounds, and with reactions, processes, and methods for obtaining the thousands of compounds continually being added to and produced as useful materials or as illustrative substances or as addenda of the science To treat of all of these is an enormous task by itself, if, in addition, a chemical dictionary attempts to make clear the interdependence of chemistry and the other branches of natural science—physics, biology, crystallography, and geology—and the arts of medicine and pharmacy, and also makes reference to those associated with the development of chemistry and the cognate sciences, it must attain a very considerable size and be frequently brought up to date if its usefulness is to be maintained

The production of a one volume chemical dictionary is, therefore, a great achievement, and Prof Hackh has rendered an important service to chemists and chemistry The volume is not too bulky to be handled conveniently and, for the most part, the information given is reasonably accurate and, in many cases, surprisingly detailed It is almost a super-dictionary, the author being rarely content to give a mere definition or description

It must be allowed that no dictionary will ever be found fully satisfactory in all details to all who may consult it The specialist in any one subject cannot expect to be satisfied with the necessarily

brief account given in a dictionary of those portions of the subject of which he can claim to be an authority It would not be surprising, for example, if even "The Oxford Dictionary" fails on occasion to satisfy the critical faculty of those cross word puzzle enthusiasts who are also readers of the *Times*

To illustrate the excellent features of Prof Hackh's dictionary would be impossible in a review of reasonable length, and reference can only be made to one or two Under 'hydrogen ion', there are, apart from the definition, a table of hydrogen-ion concentrations, references to and illustrations of hydrogen ion determinations by the electro metric and colorimetric methods together with a cross reference to 'indicator', where rather more than $2\frac{1}{2}$ pages are devoted to tables showing various indicators and the hydrogen ion concentration corresponding to the colour change in the cases of some 74 After the description of Paul Ehrlich as a German biochemist and the founder of modern chemotherapy, there is an outline covering $1\frac{1}{2}$ pages of Ehrlich's side chain theory and of other out standing features of his work It would be inter esting to discover how many organic chemists will familiarise themselves with the three pages of abbreviated structure formulæ of typical organic compounds, but this method of representation has saved many pages

Many 'articles' are illustrated by diagrams, for example, the triple point diagram for water is given under 'triple point', and the equilibrium diagram of the ternary system, lead bismuth tin, occurs under 'alloy' It would scarcely be reasonable to expect, but it would be useful to many readers to have, some explanation, however brief, of such diagrams, even if this could only be given by omitting illustrations of familiar apparatus such as an Erlenmeyer flask, a tripod, a burette stand, or even the photographs of chemists and physicists There is an adequate reference to 'parachor', even if the mathematical expression is inaccurate owing, possibly, to a printer's error The description of acetophenone in two places as 'benzoyl hydride' needs revision, and perhaps the author would have been well advised to omit at this stage the structural formula given to strychnine

The dictionary refers to the leading chemical societies, of which our own takes precedence on account of its date of foundation It also aims at being something in the nature of a chemical biography and, so far as living chemists are concerned, the present writer has gained the impression that the majority appear to be American Prof Armstrong is mentioned, but it may be regretted that his photograph does not appear on the opposite page to that of Arrhenius! We are tempted to wonder why there is no mention of H B Baker, W H Perkin, junr, R Robinson, J F Thorpe, R Willstatter, and H Wieland among chemists, and why J J Thomson and Eddington find no place in the gallery which includes Aston, Bohr, Einstein, Moseley, Rutherford, and C T R Wilson

There are, however, so many good points about the dictionary that one becomes perhaps unduly impressed by the relatively few defects, from whatever cause they have arisen, but which can easily be remedied in a future edition

C S Gibson

The Oligochæta

The Oligochæta By Dr J Stephenson Pp xvi + 978 (Oxford Clarendon Press, London Oxford University Press, 1930) 60*s* net

THIRTY FIVE years ago the Clarendon Press published Beddard's well known "Monograph of the Order Oligochæta", but in the interval numerous investigations have been made on the structure, embryology, and physiology of these animals, and much more has been learnt of their ecology and distribution The time was ripe for a new monograph, and zoologists are grateful to Dr Stephenson for undertaking its preparation With the exception of Prof Michaelsen of Hamburg, it is doubtful if any other author could have successfully surveyed the whole order Dr Stephenson brought to the preparation of this work a thorough practical mastery of the structure and classification of the Oligochæta, an extensive knowledge of the literature and a flair for conciseness and clearness in presenting facts and conclusions, and he has produced a monograph of exceptional merit

The book consists of twenty chapters, a bibliography, a subject index, and a systematic index The first ten chapters give a systematic account of the external characters and of the structure, histology, and physiology of the various tissues and systems of organs—alimentary, vascular, excretory, nervous, and reproductive That on the alimentary canal includes consideration of the chromophil cells, the peptonephridia, and the calciferous glands which are produced by folding of the œsophageal epithelium, and are therefore not of mesodermal origin as some authors have suggested The chapter on the vascular system opens with an account of the arrangement of the blood vessels in *Lumbricus*, followed by a comparative consideration of each group of vessels in the Oligochæta and of their histology, concluding with a brief discussion of the

evolution of the vascular system in which the views of Lang (the trophocœl theory) and of Vejdovsky are set forth The following chapter on respiration gives a clear account of the mechanisms of respiratory interchange through the body wall—in which there may or may not be networks or loops of blood vessels—or by the agency of gills which are present in half a dozen genera, and of intestinal respiration which is met with in certain aquatic Oligochæta and to which the author devoted considerable attention some years ago

A description of the anatomy and histology of the Lumbricid nephridium prefaces the account of the half dozen main types of nephridia found in Oligochæta A systematic survey of the nephridia in the several families, a résume of the processes of excretion, and a brief note on the evolution of the nephridial system within the order complete a masterly exposition of a difficult subject

In the chapters on the nervous system the author has described the various neurones and their relations to one another and the remarkable giant nerve cells and fibres, has discussed the physiology of the nervous system in relation to the various types of locomotion, and has added a short note on the psychology of earthworms

The tenth chapter (115 pp), the longest in the anatomical part, is by far the best comparative account available of the gonads, their ducts and associated glands, the spermathecæ, the spermatophores, the modified genital setæ and the clitellum The three following chapters deal with spermatogenesis, oogenesis, fertilisation, copulation, oviposition, embryology, and asexual reproduction

In the fourteenth and fifteenth chapters are recorded the chief anomalies of structure and malformations, for example, bifurcation of one or both ends, and the principal results of investigations on regeneration and transplantation for which earthworms have been extensively employed

The following chapter on the ecology and manner of life of the Oligochæta contains a selection of the most interesting observations on these subjects from the literature of the last thirty five years, for example, reference is made to the very small oxygen requirements of certain aquatic forms—a species of *Limnodrilus* occurs in Peoria Lake (near Chicago) where the dissolved oxygen was found to be less than one part in a million—and to the number of earthworms in the soil, which appears to be considerably greater than was stated by Darwin The highest numbers recorded are for a meadow near Zurich, in which 700 Lumbricidæ and 8000 Enchytræids per square metre were found

The excellent chapter on geographical distribution deals clearly among other subjects with the views of Michaelsen and of Benham regarding the value of the evidence afforded by the distribution of Acanthodriline worms concerning the former existence of a more extensive antarctic continent The author adds his own careful conclusions on the bearing of the known facts of geographical distribution on the former existence of Indo Australian and other land bridges

The discussion of the phylogeny and affinities of the Oligochæta includes interesting observations on convergence and on polyphyly

In the concluding chapter, the author adopts a scheme of classification of the Oligochæta into fourteen families The Acanthobdellidæ are not included , they are regarded as leeches For each family a concise definition, a note of its distribution, and comments on the chief structural characters and on ecology are given The further systematic consideration is restricted to the genera—about 120—under each of which is a definition, reference to its distribution and a note of the number of species, with comments on special features The author states that the number of species of Oligochæta now known is about 2400, twice as many as were known in 1900, the revision of which would be a formidable task He makes a strong plea in the preface for the careful identification of specimens used in research and for the avoidance of such meaningless expressions as ' the earthworm ' or ' the common earthworm ', and points out that the phrase " the common earthworm, *Lumbricus terrestris* " is for many parts of the country fallacious, this worm being often less common than one or two species of *Allolobophora*

The bibliography of more than 1000 papers includes the most important works down to October 1928 and a few more recently issued Only about 80 bear date previous to 1895, the author rightly considering that the papers of an earlier date had been dealt with by Beddard or that the subjects of which they treat had been reinvestigated by newer methods

The illustrations have been carefully chosen, nearly all from recent memoirs A miscalculation of the number of earthworms per square metre from the figures per acre is the only mistake the reviewer has noticed, and the book appears to be entirely free from misprints The author is to be most heartily congratulated on his masterly monograph, which will undoubtedly be for many years the authoritative work of reference on the Oligochæta J H A

Our Bookshelf

Die Technologie der Fermente Herausgegeben von Prof Carl Oppenheimer Halbband 2 *Fermente in der Fettindustrie, Milchwirtschaft, Lederindustrie, Gelatine und Leimindustrie, Pharmaz Industrie, Malzextraktindustrie, Textilindustrie, Nahrungsmittelindustrie* Pp xi + 370 (Leipzig Georg Thieme, 1929) 42 gold marks

The work before us forms the completion of the fourth volume of Prof Oppenheimer's great treatise "Die Fermente und ihre Wirkungen" The fourth volume is entitled "Die Technologie der Fermente", the first half volume of which was compiled by Dr Albert Hesse of Munich The subject matter it dealt with may be gathered from its title, "Enzymatische Technologie der Gährungs industrien" The second half-volume, which is now under review, is concerned with the subjects given above under the sub title

The hydrolysis of fats on an industrial scale by the lipases is dealt with by Dr Emil Hoyer, whose article contains 17 illustrations Dr W Grummer's short article on enzymes in the milk industry is concerned with the technology of rennet A comprehensive monograph of 116 pages on the leather industry includes 21 illustrations and is contributed by Dr Otto Gerngross following which is a short article of four pages by the same author on gelatin and glue The article by Drs P Bergell and H Carls on enzymes in pharmacology covers 102 pages and contains five illustrations The concluding three articles are by Dr A Hesse, the subject matter being commercial malt extract, the significance of enzymes in the textile industries, and industries concerned with foods They occupy 13, 79, and 69 pages of text respectively

Throughout the work citations are made to scientific papers as well as to patent specifications

Prof Oppenheimer may be congratulated in having, with the help of his collaborators, produced an exceedingly valuable treatise on a department of science of ever increasing industrial importance

A R L

Vorkommen und Geochemie der mineralischen Rohstoffe Einführung in die Geochemie und Lagerstättenlehre, besonders für Chemiker und Studierende der allgemeinen Naturwissenschaften Von Prof Dr Georg Berg Pp x + 414 (Leipzig Akademische Verlagsgesellschaft m b H , 1929) 28 gold marks

In accordance with the modern tendency, Dr Berg regards the study of mineral deposits as 'applied geochemistry' His book, moreover, does not deal exclusively with ore deposits in the strict sense but includes deposits of all the useful minerals It is divided into two parts Part 1 consists of an introduction to geochemistry, and treats of the general factors underlying the distribution and migration of elements within the crust and interior of the earth, and the particular factors upon which their local enrichment to workable bodies depends In this part is given a good summary of all modern work on the subject

In Part 2 the elements are considered individually, although there is a primary grouping into certain classes, and in certain cases two closely related elements may be treated together The various mineral species are dealt with, and in every case the actual mode of occurrence is regarded as a function of all the geochemical characters of the element in question By this means the genetic relationships are made clear and the paragenesis of both elements and minerals takes on a new significance In a book of this nature it is quite impossible to describe every known deposit of each element nevertheless, the author has selected representative examples of the important types from world sources The text is illustrated throughout with numerous diagrams and sections

Travels in the Congo By André Gide Translated from the French by Dorothy Bussy Pp ix + 375 + 16 plates (New York and London Alfred A Knopf, 1930) 15*s* net

This volume, which is a translation of "Voyage au Congo" and "Le Retour du Tchad", published in 1927 and 1928, is the embodiment of an ambition realised after thirty six years It is appropriately dedicated to Joseph Conrad André Gide, the distinguished French man of letters, has here recorded the day to-day events and the impressions stored up in a journey by road and river, in boat and car, but mostly on foot, through the Belgian and French Congo to Lake Chad The reader should feel no disappointment at finding this no scientific record beyond an amateur interest in the more remarkable fauna of the tropics, and to some greater extent in the lepidoptera and flora, the author had not the equipment for systematic observation But nevertheless, as a vivid impressionistic picture of life and travel in tropical Africa, it has a value Native life and character stand out in the round against a background of the forest Though the author started, as he himself confesses, with little interest in the native and his relations with the white inhabitants and the administration, this soon became the main interest of the journey It is beyond question that his intervention brought to the notice of the administration many abuses in treatment of the natives by the commercial companies to whom concessions had been granted

Experimental Physical Chemistry By Prof F Daniels, Prof J Howard Mathews, and Prof J W Williams (International Chemical Series) Pp xvi + 475 (New York McGraw-Hill Book Co , Inc , London McGraw Hill Publishing Co , Ltd , 1929) 17*s* 6*d* net

Although there is no lack of good English text books on practical physical chemistry, the present volume forms a welcome addition to the literature of the subject It covers the range of experiments usually done by students in Great Britain, and gives in addition a number of alternative experiments of a more advanced character which will make the book useful to those beginning research There are useful references to literature The book should be available in every physico-chemical laboratory

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

The Parachor and Molecular Volume

DR SUGDEN has put physical chemistry very much in his debt by his introduction of the concept of the parachor Simply defined as this is in terms of Macleod's fundamental discovery that the surface tension of a liquid at any temperature is in a constant ratio to the fourth power of the difference of the orthobaric densities of liquid and vapour measured at the same temperature, the parachor has proved, as a weapon of attack on the problems of chemical constitution, much more powerful than the molecular volume

If we write Macleod's law in the form

$$\gamma^{1/4} = K(D - d),$$

the parachor P is simply the constant K multiplied by the molecular weight, putting, therefore,

$$P = M\gamma^{1/4}/(D - d),$$

it follows, as Dr Sugden rightly points out, that, if d is negligible in comparison with D, a comparison of the parachors of two substances is a comparison of two molecular volumes at temperatures such that the surface tensions are equal But the step from this argument to the assumption that a parachor (Sugden, *Jour Chem Soc*, 125, 1177, 1924, and T M Lowry, NATURE, Mar 8, p 364) " is in fact a molecular volume which is independent of the temperatures at which it is measured ", and which " therefore replaces, with greatly enhanced efficiency, the old molecular volumes " is quite unjustifiable

It is true that two speeds may be compared by comparing the lengths covered in equal times, but this does not provide the slightest justification for asserting that a length *is* a velocity Just as much, or as little, is a parachor a molecular volume, and one is not forwarding the use of this valuable concept by calling on it to play a rôle for which it is by no means fitted The parachor, as parachor, has assisted in the elucidation of a number of constitutional problems—there is nothing to be gained, and much to be lost, by rechristening it a molecular volume

The dangers attendant on this attitude are well illustrated by a study of a table drawn up by Dr Sugden He remarks (*Jour Chem Soc*, 125, 1177, 1924) that if the parachor " is a true measure of the molecular volume it should bear an approximately constant ratio to the critical volume ", and he gives a table, reproduced in extended form on p 31 of his interesting volume "The Parachor" which shows that the relation $P = 0\ 78\ V_c$ can be used to predict the molecular critical volume to within about 3 per cent Now, whatever we may think of the rational basis of Dr Sugden's hypothetical syllogism, we have good ground for assuming that the ratio P/V_c is *not* a constant Some little time ago, I showed (*Trans Far Soc*, 1923) that Macleod's constant C in the equation

$$\gamma = C(D - d)^4$$

may be expressed in terms of the molecular weight and critical constants of the liquid by

$$C = \Delta\theta_c/M^{2/3}\rho_c^{10/3}$$

where Δ is a 'universal' constant If we replace ρ_c by the critical molecular volume V_c and remember that the parachor P is equal to $MC^{1/4}$, we easily find that

$$P = \Delta_1\theta^{1/4}V_c^{5/6}$$

Hence it is not P/V_c which we should expect to be constant, but Δ_1, where

$$\Delta_1 = P/V_c^{5/6}\theta_c^{1/4} \text{ or } (P/V_c) \times (V_c^{1/6}/\theta_c^{1/4})$$

I reproduce here Dr Sugden's table with one or two additional columns, and if the columns headed P/V_c and Δ_1 respectively be compared, it will be seen that the constancy of the numbers in the column last mentioned is very considerably improved

Substance	P	V_c	θ_c	P/V_c	$\Delta_1 = P/V_c^{5/6}\theta_c^{1/4}$
Hydrogen	35 1	[46 9]	33 1	[0 75]	0 440
Methyl formate	138 6	172 0	487 1	0 81	0 406
Methyl acetate	177 0	227 8	506 8	0 78	0 405
Benzene	206 3	256 1	561 6	0 81	0 417
Carbon tetrachloride	219 9	276 1	556 3	0 80	0 418
Diethyl ether	211 7	281 9	466 9	0 75	0 414
Methyl propionate	215 0	282 0	530 5	0 76	0 407
Propyl formate	216 1	284 8	538 0	0 76	0 404
Ethyl acetate	217 1	286 3	523 2	0 76	0 407
Chlorobenzene	244 5	307 8	632 3	0 80	0 412
Methyl isobutyrate	253 3	338 9	540 7	0 75	0 409
Methyl butyrate	254 2	340 1	554 4	0 75	0 408
Ethyl propionate	254 8	344 3	546 0	0 74	0 405
Propyl acetate	256 1	345 3	549 3	0 74	0 406

The numbers for hydrogen are a little difficult to follow Dr Sugden gives the critical molecular volume of hydrogen as 46 9 Landolt Bornstein and the " International Critical Tables " agree in giving as the most probable value, Kamerlingh Onnes' figure of 0 03102 for the critical density This gives 64 5 as the critical molecular volume If now we take Dr Sugden's value of 46 9, the ratio P/V_c is about 0 75, but the value of Δ_1 is very far from the mean value 0 409 On the other hand, the accepted value of 64 5 makes the ratio of P/V_c equal to 0 53, but the constant of the last column is now 0 44, as close to the mean as one would expect with a substance such as hydrogen

There is very little doubt that it is preferable to treat the parachor as a parachor, and to discuss the problem of molecular volumes on an entirely independent basis As Prof Lowry remarks (in rather stronger terms than is justifiable) Kopp's attempt to regularise the values of molecular volumes by measuring them at the boiling points of the liquids concerned was not an unqualified success One has to remember however, that boiling points are only very approximately corresponding temperatures The ratio of boiling point to critical temperature varies, for example, in a perfectly regular manner for the homologous series of normal paraffins

It is possible—if indeed the attempt has not already been made—that a number of these irregularities would be removed if molecular volume determinations were carried out at exactly corresponding temperatures I have recently developed an equation showing the variation of the orthobaric density (ρ)

of an unassociated liquid with reduced temperature m, which takes the form

$$\rho = 2\rho_c[A(1-m)^{0.3} + (1-m/2)],$$

where A is a constant which to a first approximation may be taken as unity. With the exception of a few degrees in the neighbourhood of the critical temperature, this equation represents the behaviour of an unassociated liquid with an accuracy equal to that of experiment. The equation shows that, if comparisons be made at *strictly* corresponding temperatures, a comparison of molecular volumes reduces to a comparison of critical molecular volumes, and it is possible that regularities may emerge from a search made in this direction. However that may be, it is certain that a parachor is not a molecular volume. The parachor is a healthy infant, strong enough to fight its own battles in its own name, and its friends will be well advised to treat it as an independent concept.

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Parasitism a Stimulus to Pupation. *Alysia manducator* in Relation to the Host *Lucilia sericata*.

CONSIDERABLE diversity of opinion has been expressed regarding the stage in which hibernation of the 'blow fly', *Lucilia sericata* Meigen, takes place. Records are given variously as:

(*a*) Mainly in the pupal, but also in the larval stage [1]
(*b*) Both in pupal and larval [2]
(*c*) In the larval stage [3]

In investigations in progress for the Australian Council for Scientific and Industrial Research, on the biological agencies which play a part in limiting the numbers of this fly, the question of hibernation has been brought into close apposition with that of parasitism by the Braconid, *Alysia manducator* Panzer.

Originally it appeared that hibernation of the host might take place in more than one stage, for both larvæ and puparia were recovered from the soil surrounding baits exposed in the autumn and examined towards the end of the season, five weeks later. The mean daily temperature from the time the larvæ had reached a stage of development normally leading to pupation, and for three weeks prior to examination, had been 8.5° C. As the daily range in temperature was small and the weather dull, the mean air temperature was no doubt a reasonable approximation to that of the soil to which most of the larvæ had migrated. Of the larvæ collected, some pupated a day or two after being brought to the laboratory, while others did not; the latter have undergone a tardy pupation on encountering higher temperatures, and the larval life of some of them at an average temperature of 15° C was prolonged to three months.

The mean temperatures obtaining in the field at the time the material from the bait was collected were such as are usually associated with hibernation. Thus it seemed highly improbable that the puparia taken from the field were those which would complete their development and produce flies before the winter. In other words, it appeared that hibernation might be possible in both larval and pupal stages. The parasitism records, however, have yielded some interesting results, which necessitate a different interpretation of the facts. From larvæ which had not pupated within eight days of being brought from the field the percentage parasitism has been negligible; practically all the parasitism records have been obtained from puparia or larvæ which pupated soon after collection, as will be seen from the following table:

TABLE I

Batch	Stage	Number	Parasitised	Parasitism
1	Larvæ	198	1	0.5%
	Puparia (plus larvæ pupated within 8 days of collection)	198	173	87.4%
2	Larvæ	70	6	8.6%
	Puparia (plus larvæ pupated within 8 days of collection)	128	119	92.2%

It appeared then, since practically all the parasitism was associated with those forms which had passed into the pupal stage, while those which remained as larvæ were unparasitised, that there might be some relation between host pupation and parasitism.

Of several thousand larvæ removed from the field a month earlier which had completed their development under cool conditions indoors, a proportion also had pupated, though the majority had remained in the larval stage. If, then, the relation which appeared to exist between parasitism and host pupation were a fact, it seemed reasonable to expect that confirmation might be obtained from those forms collected a month earlier, which, under cool conditions were apparently hibernating in part as larvæ and in part as puparia. One hundred of each stage were therefore dissected and the results were as follows. (One hundred larvæ left under the same conditions have continued to hibernate without pupation.)

TABLE II

Stage	Number	Parasitism
Larva	100	0 per cent
Puparium	100	88 per cent

As there was a possibility that the presence of parasites, more especially in the egg stage, may have escaped detection in the host larvæ, an additional hundred larvæ were put to pupate. (The parasite is present as a reasonably well developed larva after the host has pupated and its detection is therefore assured.) Of these, 87 pupated and 13 died. All were dissected. A further 100 puparia were also placed aside to emerge for confirmation of the species of parasite. The results from these extra larvæ and puparia confirm those already given.

TABLE III

Stage	Number	Parasitism
Larva	100	0 per cent
Puparium	100	89 per cent

It appears, then, that the retardation by low temperatures of the physiological events normally leading to pupation may be overcome by a stimulus contributed by parasitism.

Of the parasites obtained from the four groups of puparia given in the foregoing tables, *Alysia manducator* has predominated to the extent of 93.6, 99.1, 96.6, and 98.9 per cent respectively. The remaining parasitism was by *Aphæreta minuta* Nees, which appears to produce an effect similar to that caused by *Alysia*.

Altson [4] was of the opinion that 'successful para-

sitism ' by *Alysia manducator* caused the host larvæ to burrow, although he does not record any experiments on the point As most of his observational and experimental work was done on *Calliphora erythrocephala*, it was no doubt this species to which he referred One hesitates to accept the idea that ' successful parasitism ' by *Alysia manducator*, if this means the actual presence of an egg capable of development within the host, is the cause of stimulated pupation in *Lucilia sericata* It may be that the real cause is the secretion injected at the time of oviposition and which causes temporary paralysis of the host larva If this were the case it would probably account for some host pupation as a result of the injection without the deposition of the egg, and explain why in the foregoing tables all puparia did not yield parasites Interruptions in the oviposition act are common enough and due to a variety of causes Experimental work on this point is in progress

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[1] Graham Smith G S *Parasitol* 8, 4, 440 544 1916
[2] Kisliuk M *Ohio Jl Sci* 17, 8, 285 294, 1917
[3] Davies W M, NATURE 123, 759 760 1929
[4] Altson A M, *Proc Zool Soc Lond* 15, 195 243, 1920

Penetration of Methylene Blue into Living Cells

IN NATURE of June 16, 1928 (vol 121, p 939), Irwin has commented adversely on certain quotations of my results on the penetration of methylene blue into living cells It seems important, therefore, to direct the attention of readers of NATURE to subsequent findings made by me

In these new experiments (M M Brooks, *Protoplasma*, 7, No 1, 46, 1929) it was found that differences between Irwin's methods and those used by me were responsible for differences in the results Irwin's experiments were done with a very much higher pH value of the external solution, a much more concentrated solution of dye in the external medium (from 3 to 25 times as concentrated), and a more impure dye, and in darkness rather than in diffuse daylight

Experiments done according to methods used by me again showed that methylene blue penetrates living cells as such and not as one of its lower homologs When Irwin's methods of experimentation were used, trimethylthionine was found in the sap, showing without doubt that her results were due either to high pH value which alters the dye, to the impurity or high concentration of dye which she used in the external solution, to the difference in illumination, or to some combination of these factors It is also important to consider what part is played by injury, plants placed under the adverse conditions of Irwin's experiments are undoubtedly more abnormal than those subjected to such mild treatment as that used by me

There is no reason to doubt the validity of the spectrophotometric analyses made for Irwin by W C Holmes and K S Gibson of the Bureau of Standards, Washington, D C The error lies in the solution which was submitted to them for measurement

It is apparent that the purer the methylene blue, and the less abnormal the experimental conditions, the more nearly will methylene blue be found uncontaminated in living cells

Discussion of contradictory results obtained by different workers will scarcely advance our knowledge of cellular biology unless due consideration is given to possible differences in experimental methods It is a simple matter to confirm the observation that methylene blue as such penetrates normal living cells, provided proper methods are used

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Photo-Decomposition of Molecules having Diffuse Band Spectra

THE products of photo decomposition of molecules showing diffuse discontinuous band absorption spectra (predissociation spectra) where, according to Bonhoeffer and Farkas (*Z physik Chem*, 134, 337, 1928), the light produces dissociation by internal energy exchange, without collision, can be studied readily in the case of ammonia

If ammonia at a few millimetres pressure be introduced into a quartz tube containing the yellow tungstic oxide and the gas be illuminated with a hot mercury vapour arc, reduction to the blue oxide of tungsten occurs with a few minutes exposure This ready reduction points to the presence of atomic hydrogen in the decomposition products The result is not unequivocal, since there might be (Bates and Taylor, *J Am Chem Soc*, 49, 2438, 1927) hydrazine formed in a stepwise decomposition of the ammonia, and it is known that hydrazine reduces tungstic oxide at room temperature

The formation of atomic hydrogen is, however, indicated by the following experiment Mixtures of ammonia gas, hydrogen, and carbon monoxide when streamed through a quartz tube illuminated by the mercury arc produce marked quantities of formaldehyde and also a considerable deposit upon the sides of the tube of a white solid, soluble in water, which appears to be hexamethylene tetramine This reaction definitely points to a dissociation of ammonia yielding atomic hydrogen, since the activity of this latter in producing formaldehyde from hydrogen and carbon monoxide is well known (Taylor and Marshall, *J Phys Chem*, 29, 1140, 1925) This method of producing atomic hydrogen in controlled amounts by regulating the intensity of illumination of ammonia and other molecules showing diffuse spectra is well adapted to the study of reactions induced by introducing atomic hydrogen in various gas mixtures Such studies are in progress here

HUGH S TAYLOR
JOHN R BATES

Department of Chemistry,
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Princeton, New Jersey,
Mar 4

Intensities in the Atmospheric Oxygen (Intercombination) Bands

WE have made exact intensity measurements of the *A* group of the absorption bands of oxygen at λ7600 A with the aid of the ' raster ' method of Frerichs,[1] using a 6 4 metre concave grating, infra red sensitive plates, and three different lengths of light path, respectively 14, 33, and 60 metres It was found that the exponential absorption law $J = J_0 e^{-kd}$ holds for these absorption lines, for the 33 metre light path, assuming that the peaks of our photograms can be identified with the true absorption co efficient, we find for the strongest line an absorption $\frac{J_0 - J}{J_0}$ of 27 per cent

Knowing the temperature of the absorbing gas (air, room temperature) and the true energies of the

rotational levels[2] it is possible to compute the transition probabilities of the rotational levels, since the Boltzmann factor is exactly known According to Mulliken, these bands are a $^1\Sigma - {}^3\Sigma$ combination, the ground level of the molecule being the $^3\Sigma$ state The lines obey the following relations

$$P_3(j) = F'(j) - F_3''(j+1), \quad R_2(j) = F'(j) - F_2''(j-1)$$
$$P_2(j) = F'(j) - F_2''(j), \quad R_1(j) = F'(j) - F_1''(j)$$

The intensity relations (not hitherto known for intercombination bands of this type) which are found to hold are as follows (omitting the Boltzmann factor $e^{-E/kT}$)

$$\text{Intensity of } P_3(j) = \tfrac{1}{2}(j+2) \qquad R_2(j) = \tfrac{1}{2}(j-1)$$
$$P_2(j) = \tfrac{1}{2}(j+1) \qquad R_1(j) = \tfrac{1}{2}(j)$$

For small values of j, there are small deviations which we believe to be real and which are proportional to reciprocal values of j The summation rule $P_3(j) + P_2(j) + R_2(j) + R_1(j) = 2j + 1$ is therefore obeyed only for the higher values of j The mean error of the measurements, of which a full account will be given later in the *Zeits f Phys*, is about 3 4 per cent

W H J CHILDS
R MECKE

Physikalisches Institut d Univ,
Bonn, Feb 20

[1] R Frerichs, *Zeits f Phys*, 31, 305, 1925
[2] R M Badger u R Mecke, *Zeits f Phys*, 60 59 1930

The Hybridity of *Drosophila melanogaster*

I AM very much attracted by Prof Jeffrey's remarks in NATURE of Mar 15 on the hybridity of *Drosophila melanogaster*, partly because I also think hybridisation (internal or external) of great evolutionary importance But the tangle of genetical and cytological literature has obscured so many of the issues involved that I feel Prof Jeffrey would do us a great service in elaborating some of his ideas and defining others

What, for example, is a hybrid? How are we to define it and how are we to recognise it? These are questions that Prof Jeffrey with his clear cut ideas will be able to answer directly The working geneticist and cytologist cannot deal with them so easily He cannot see the wood for the trees

One would like to know also in simple terms how variation is connected with hybridity in, say, *Drosophila melanogaster* and *Œnothera Lamarckiana*? Is it what Mendelians call 'segregation'? Or is it due to crossing over? Or can we perhaps ascribe it to an irritability of the germ plasm induced by the hybrid condition? If we knew these things we might be able to make some notable generalisations

Again, with regard to the pairing of chromosomes, I agree with Prof Jeffrey in attaching great importance to failure of pairing, but I hesitate to give it a general cause Does it happen for the same reason in *Drosophila*, *Œnothera*, *Drosera*, and *Tradescantia*? Perhaps Prof Jeffrey can show that it is always due to hybridity, and that will be a great help in understanding meiosis Perhaps he can show, also, that lagging chromosomes are always due to the same condition

Finally the student would like to know what Prof Jeffrey thinks of the criticisms of *Drosophila* workers, such as Metz, Bělař, Huettner, Guyénot and Naville, and Zuitin Are their suggestions, that Prof Jeffrey's lagging chromosomes in *Drosophila* are really cytoplasmic bodies, to be taken seriously, or are they merely irrelevant?

C D DARLINGTON

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Merton, Mar 20

Raman Effect in Water

IN a previous communication (NATURE, Nov 16, 1929) the peculiar changes in the Raman bands for water in solutions of nitric acid were mentioned Work with many other strong electrolytes, acids, bases, and salts, has confirmed this behaviour Study of the bands with ice and with water at higher temperatures has revealed interesting features connected with this Pure water gives three bands corresponding to infra red wave lengths of about 3 12, 2 93, and 2 79 μ, which are diffuse and merge into one another In electrolytic solutions, however, these three bands become sharper with increasing concentration of the electrolyte The band corresponding to 3 12 μ gradually diminishes in intensity until, in very concentrated solutions, it entirely disappears On the other hand, the band corresponding to 2 79 μ, which is the weakest of the three in pure water, becomes stronger in intensity with increasing proportion of the electrolyte, until, in very strong solutions, it becomes equal in intensity to the central band, which is the most intense of the three in pure water

A study of the variation with temperature of the distribution of the intensities of these three bands has shown a similar behaviour, the band corresponding to 3 12 μ diminishing in intensity with increasing temperature, while that for 2 79 μ increases Crystalline ice has shown an entirely different behaviour The intensity of the central band is the same as in water But the band corresponding to 3 12 μ is stronger in intensity than in water, the band for 2 79 μ being weaker still in ice Thus the behaviour of water in electrolytic solutions, instead of being similar to that in crystalline ice, is exactly opposite to it It behaves more like water at higher temperatures This is a surprising result, being contrary to existing ideas regarding the nature of water in solutions

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Dipole Moment of some Organic Halides

IN a note published in NATURE (Mar 16, 1929), Prof P N Ghosh pointed out from the results of Mahanti and Das Gupta (*Ind Jour Phys*, 3, 467, 1929) that the OH radical is mainly responsible for producing the dipole moment in the case of the saturated normal alcohols, whether the carbon chain is open or closed, long or short Recently (in a paper communicated to *Phys Zeit*) Mahanti has shown that the dipole moment is sensibly constant for a homologous series and its magnitude depends on the nature of the polar group, radical, or atom in the corresponding homologues According to his view, all the alkyl chlorides should have a dipole moment of the order of 2×10^{-18} e s u and the bromides of the order of $1\ 79 \times 10^{-18}$ e s u I have determined the dipole moments of a few organic halides by a heterodyne method and they agree well with the views and results of Mahanti They are

	$\mu \times 10^{18}$
Propyl chloride	2 07
Allyl chloride	1 99
Propyl bromide	1 78

D N SEN GUPTA

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Calcutta, Feb 11

Earth Movements in the Delta of the Rhone

By R D OLDHAM, F R S

DELTAS are essentially areas of instability The very existence of a large delta is dependent on changes of level of the land, and not merely a general subsidence, but a special local sinking of the deltaic region in comparison with the surrounding land Nor is this all, for there can be few deltas, if any, in which the general movement in a downward direction has not been interrupted at intervals by one in the opposite direction, and in which more or less extensive areas of upraised alluvium cannot be found To this rule the delta of the Rhone is no exception, but there is no other instance in which the amount of this change can be measured, or the date fixed at which it took place, with so close a degree of accuracy as can be done for some of the changes which have taken place at the mouth of the Rhone

Readers of NATURE may remember that this subject was referred to in articles on "Problems of the Rhone Delta", which appeared in the issues of July 4, 11, and 18, 1925 It was there pointed out that the geological work of M G Denizot had demonstrated an uplift of the land in the pre historic past, by which the original alluvial deposit of the delta was raised to a level at which further accretion was brought to an end and an undulating land surface developed by denudation, a surface on which the Romans built their homes and monuments, and of which large areas are still in evidence, though a larger part has been buried under fresh deposits of alluvium formed at a later date It was also pointed out that there was evidence of a subsidence of the land, amounting to about 5 metres, having taken place between the beginning of the eighth and the end of the ninth centuries Since those articles were written, I have been able to collect a much larger volume of evidence bearing on the problems indicated in the earlier articles, and an epitome of the results, as they affect this question, of past changes of level, will probably be of interest

The position of the mouth of the Rhone in Roman times can be fixed with certainty and a fairly close approach to precision from the maritime itinerary, first compiled in the first or second century of our era It lay sixteen Roman miles from the port of Fossae Marianae, now represented by the seaside resort of Fos-sur Mer, and this would bring it to the locality where is now the Grau de la Dent at the mouth of the Vieux Rhône, or channel occupied by the river during the seventeenth century, the existing sea coast being at this point almost coincident with the ancient shore line of pre Roman and early Roman times At Arles the channel of the Roman Rhone seems to have followed very closely the course of that in which it now flows, and local conditions preclude any wide departure from it At about ten kilometres below Arles the channel can again be fixed within narrow limits, a spur of the gravels of the Crau puts an absolute bar on any course lying east of the present one, and within less than 3 kilometres to the west comes a spread of the old pre Roman land surface carved out of the upraised alluvium Within these narrow limits the Roman Rhone must have flowed, but below this there is no certainty, except that it never flowed past Passon or by any of the channels below that point, which have been followed at various times from the twelfth century to the present day The most likely interpretation is that it followed the general course of the present Aube de Bouic to near the shore of the Étang de Vaccarès, thence southwards to the east of Fiélouse and the ruins of the Abbey of St Ulmet, and then to the same general course as was followed by the last 8 or 10 kilometres of the seventeenth century channel, which is still known as the Vieux Rhône Measured along this course, the thirty Roman miles given in the itinerary as the distance by river from the mouth to Arles, would correspond very closely with the actual length of channel

With the end of the Roman dominion the records become scanty and fragmentary, until the close of the twelfth century, when we find an entirely different state of things The seaport of Fossae had disappeared, the entrance to the main channel of navigation was at the mouth of what is now the Étang de Galéjon, on the western shore of which there is a group of low hills, then known as Odor, and later as La Roque Passing this a broad stretch of inland lagoons was traversed to the neighbourhood of Passon, where further progress was only possible along a single channel, narrow and barely deep enough to admit even those vessels of small tonnage by which the bulk of the sea traffic of those days was carried This channel, known as the Grau de Passon, led into a wider and more open one coming down from Arles, and was the cause of constant anxiety to the council of that city, for fear that it might become blocked by obstacles to navigation Though called a 'grau', which at the present day would suggest the mouth of a river, the condition in the twelfth century was different, it is clear from later history that the real river did not flow this way, and did not reach the so called grau until after the thirteenth century had run its course The channel was a passage between two lagoons, through which little or no current flowed, and the question arises of how it could have originated It is certain that nothing of the sort existed in Roman times and that the track of vessels bound for Arles did not then run up the Étang de Galéjon, and through that channel which is crossed by the railway from Arles to Port St Louis, immediately south of the station of La Porcelette Here a small irrigation canal, deriving from the river, is all that remains to mark what was once the main channel of navigation from Arles to the sea, then for a while of the river itself, continuing ultimately as a distributory until it was artificially closed, somewhere about 1640, and ultimately converted into an irrigation canal There is but one way in which a narrow channel lying, as this did, between broader

spreads of water could have originated, and that is a general subsidence of the country and submergence of the lower levels, the narrow passage was across the strip of higher ground, known as the Plan du Bourg, which may be described as the backbone of the country east of the Rhone Besides the Grau de Passon, at least one other channel was opened across this barrier, but neither it nor any other, if such there were, was as deep or convenient for navigation

Here, then, we have a definite means of measuring the amount of subsidence which took place In Roman times the ground level of the bed of this channel must have stood above the flood level of the Rhone, and at the present day the flood waters of the Rhone near Passon reach a height of about 2 75 metres, from which we may conclude that the bottom of the channel must originally have been about 3 metres above the mean sea-level of Roman times

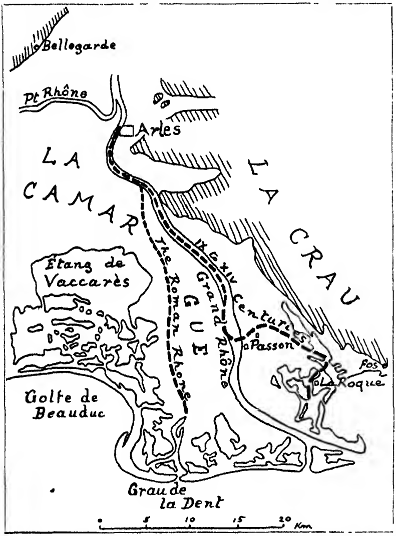

FIG 1 —Map of the eastern delta showing the main channel of navigation between Arles and the sea in Roman and in early medieval times The change from one to the other took place in the eighth century A D the eastern channel became blocked by the advance of the river about the end of the fourteenth century The course of the Roman Rhone across the Camargue has not yet been worked out in detail, that shown on the map is merely approximate

The depth of the channel at some time not later than the end of the fourteenth century was such that the bottom stood at about 2 75 metres below mean sea-level, and in the twelfth century would probably have been somewhat, though not materially, below this Adding these two together, we have proof of a change of level amounting to nearly 6 metres in all, for, taking the shallowest part of the channel, where the solid land rose to its highest level along the depression, we find that a spot which up to the fifth century had stood about 3 metres above sea level, in the twelfth lay about the same height below it, and this could only come about through a change in the relative height of land and sea, which may be described as a sinking of the land, or a rise of the sea, level, according to the point of view Four years ago this figure seemed excessive for the town of Arles, where remains of Roman structures on the banks of the Rhone show that here also there has been a change of level, which appeared to have amounted to about 5 metres, but not more than that In October last, however, when visiting Arles, I found the river standing at an unusually low level, and was able to examine the remains on the western bank more thoroughly than had previously been possible, with the result that the amount of change since Roman days must be raised to a figure of quite 6 metres, or possibly more From this must be deducted an allowance for subsidence which took place in the eighteenth century of from a half to a whole metre, so that the evidence at Arles and at Passon confirm each other in showing that the eastern delta along the present course of the Rhone stood somewhere about 6 metres lower in the twelfth than it did in the earlier centuries of our era Subsidence of this amount, in a region of such low-lying land and such low relief, must have had one result, that large areas of the lower levels would permanently sink below the level of the sea, and, as a further consequence, there would come into being a large area of shallow waters through which the river could extend its new delta with great rapidity These new lands so formed gave rise to a number of disputes over their ownership, and from the evidence recorded and the maps which were made to illustrate the claims of one party or another, it has been possible to reconstruct the main outlines, and in some cases even the details, of the geography

of the country as it stood after the subsidence was complete, but before the river had re established itself in its former territory The result, however, has only been attained after a considerable search among the ancient records, made possible by the care which is taken in France of their archives and the unfailing courtesy of the archivists in charge

The date at which this subsidence took place is as important and interesting as the amount, and so far as the eastern delta no new evidence has appeared beyond that referred to in the earlier article At the beginning of the eighth century the port of Fossae Marianae—which by this time had dropped the second word of its title—was still a mart of importance, a port of destination for sea borne commerce and, presumably, of transhipment into river going craft Its character was still the same as in Roman times, and we may conclude that the subsidence had either not yet commenced or, at any rate, had not gone far enough to affect the status of Fossae From the middle of the ninth century we find the Passon channel in full use, and nothing more is heard of Fossae as a seaport, for it had been superseded by Arles, which had become a port of destination for the overseas commerce of those times The bulk, if not the whole, of the change of level must have taken place between the commencement of the eighth and the latter half of the ninth century, and in the eastern delta the limit cannot be more closely drawn, but if we turn to the western delta we find that it also underwent a change of level comparable in amount with that which affected the eastern, and a charter of the year 788, conveying a grant of land to the Abbey of Psalmodi, shows that the subsidence, if not complete, was at any rate far advanced at that date As the grant out of the customs of Fossae, made to the Abbey of Corbie in 716, shows that the subsidence had not yet made much progress, the two together put the bulk of the movement as having taken place within the limits of the eighth century, though doubtless overlapping it at either end, and this brief period of rapid change of level came between two much longer periods of little or no change

Interesting as this would be in itself, it is by no means the whole story, for the maps of the eighteenth century make it clear that the latter part of that period saw a renewal of downward displacement of the level of the land, of shorter duration in time than that of the eighth century, and smaller in amount, the total change of level having been no more than a metre in all, and possibly less More interesting, however, than this, is the distinct suggestion of a change of level, not very different in amount from that of the eighth century, having taken place somewhere about a thousand years before our era The "Ora maritima" of Avienus, after describing the course of the Rhone from its source in the mountains, says that it enters a great marsh and mere, known in ancient times as Accion, and then, resuming its character as a river, gives off a branch towards the west On this follows immediately the mention of the bifurcation of the river and of Arles, from which it is easy to fix the position of the lake Accion Hereabouts it is known that there was a great spread of water in the Middle Ages which has largely been silted up, disappearing finally when the canal from Aiguesmortes to Beaucaire was constructed This drained away the permanent standing water, and all that is left to preserve the memory of a lake which had been important enough to be shown on a portolan map of Petrus Vesconte, is a tract of marshy ground, lying east of Bellegarde Though occupying the same position, this medieval lake cannot be accepted as a continuation, but must rather be regarded as a successor of that mentioned by Avienus, though not by the Roman geographers of the first century or by later writers, even those contemporaneous with Avienus himself In this there is nothing either of contradiction or inconsistency, for the "Ora maritima", though composed in the fifth century, was avowedly based on an ancient record, which modern scholarship has recognised as a Greek 'periplus' of about 600 B C, revised in part and at intervals of later date It is to this period that the lake Accion must be referred, which

FIG 2—Map of the seaward portion of the eastern delta, as it was from the ninth to the thirteenth century The representation is necessarily approximate and somewhat diagrammatic, the actual outline must have been more intricate, and many small islands, not shown, must have existed but nothing is represented for which there is not some authority and nothing of material importance is likely to be missing *B*, *T*, *G*, *L*, sites of the Tours de Bolovard (1469) Timpan (1606) St Genest (1656), and St Louis (1736) built by the town of Arles to guard the channels successively adopted by the Rhone

had dwindled, in later Roman times, to a condition not unlike that of the marshes of Bellegarde before they were drained in the eighteenth century History, in fact, seems to have repeated itself twice in this period, and the great spread of water which may be inferred as having been originated by the eighth-century subsidence, was preceded by a similar one, resulting from a subsidence, not greatly

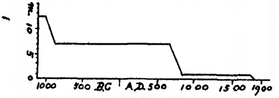

Fig 3—Variations, during the last 3000 years, in the height of the Rhone delta above sea level

differing in magnitude, at somewhere about 1000 B C In both cases succeeding centuries saw the lake gradually diminishing as it became filled up and narrowed by the alluvial deposits of the Rhone

Accepting this interpretation we may draw a graph of the level at which the delta stood, relative to the present level of the sea, for the period during which there is any historical record The result is an instructive and interesting one, for we see that, while the change has been always downward, uninterrupted by any appreciable upward movement during the last three thousand years, it has not been slow and continuous, but limited to three periods during which the change was more or less rapid, separated by much more prolonged periods during which no change took place, or only to an inappreciable extent

It is natural to inquire whether these changes were localised in the delta of the Rhone, or formed part of a widespread change in the level of the Mediterranean It is scarcely possible that a change of 20 feet at Passon would not have extended so far as Fos, only ten miles away, and this may well be the explanation of the fact that an important and prosperous town, such as was Fossae Marianae in its prime, has left no remains of buildings adequate to its former importance, the site of the docks, warehouses, and public buildings having sunk beneath the sea Farther afield, however, the evidence becomes contradictory and unconvincing, on one hand there is the existence, at several places along the coast, of Roman constructions, which archæologists have described as the remains of piers, harbours, and fish-stews, but the interpretation is a matter of opinion and open to argument, on the other hand, there are structures which must originally have been built above sea level, and are now partially submerged, but none of these gives positive proof of more than a very few feet of change, though they are not inconsistent with movement of larger amount The question calls for fuller investigation, and until this has been carried out it is impossible to assert that the changes of level which can be recognised in the deltas were not localised to that region, for the present they cannot with safety be regarded as having any bearing on the question of whether there has been a widespread change in the relative level of land and sea, affecting simultaneously and as the result of a common cause any large fraction of the Mediterranean, to say nothing of the Atlantic Ocean as well

Diet and the Teeth [1]

In the course of Prof E Mellanby's researches on rickets in dogs, which led to the discovery of the antirachitic vitamin, now known as vitamin D, it was noticed that defects in calcification were not confined to the long bones, but occurred also in the jaws and teeth of animals maintained on defective diets Mrs Mellanby followed up this point, and during the last decade has published numerous papers upon the influence of the diet upon the teeth, and also upon the relationship between dental structure and disease A detailed account of this work is in preparation, and is being published in three parts the present volume is the first of the series and is being followed by Part II, upon dental structure in other animals than the dog, and upon the production of dental disease, and by Part III, upon the structure of human teeth and the relationship between structure and caries

The dog was selected as the experimental animal of choice, since wide variations of dental structure can be readily produced it is, moreover, omnivorous, like man, and can be readily kept in health under strict laboratory conditions, it is easy to handle, and its teeth can be readily examined at any time Like man also it shows a deciduous and permanent dentition

The report describes in detail the various points to which attention was paid in each of the experimental animals, notes were made of the general health as well as of the condition of the mouth, macroscopic examination of the teeth and radiographs of the jaws and teeth during life were followed by microscopic examination of the teeth and related structures post-mortem, special attention being directed to the large carnassials in the upper and lower jaws The various grades of calcification are best studied in photomicrographs of ground sections of the teeth, of which numerous excellent reproductions are included in the report, at the same time enlarged photographs of the crowns readily show up deficiencies in calcification of the enamel

The standard basal diet used throughout had the following composition cooked cereal 100-200 gm., separated milk powder 10 30 gm, raw 'lean' meat 10-20 gm, oil or fat 10 c c, orange juice 3 5 c c, brewer's yeast 5-10 gm, and sodium chloride 1-4 gm If 3 c c of the oil consists of cod-liver oil, perfect health and perfect dental structure are observed, indicating that the diet is now adequate Small quantities of fat-soluble vitamin occur in the milk

[1] Medical Research Council Special Report Series No 140 Diet and the Teeth, an Experimental Study Part 1 Dental Structure in Dogs. By May Mellanby Pp. 308+109 plates. (London H.M. Stationery Office, 1930) 17s 6d net.

powder and in the fat remaining between the fibres of the lean meat, but not sufficient to prevent the development of marked rickets and gross defects in dental structure when the fat used contains little or none of this factor

The following influence the structure of the teeth the diet, especially its vitamin D, calcium and phosphorus and cereal content, the rate of growth and previous dietetic history of the animal or its mother and certain environmental conditions Of these the most important is the vitamin D intake

When this work was begun, vitamin D had not been differentiated from vitamin A, many experiments were carried out to determine the distribution amongst foodstuffs of the calcifying factor, in general it was found in foods which were known also to be sources of vitamin A, but certain discrepancies were observed, which in the light of later knowledge are readily explained by the fact that the two vitamins are different entities In some respects the tooth of the dog appears to form a more delicate test for the calcifying vitamin than the rickety rat, differences in potency among a series of vegetable oils being readily observed, thus coconut oil contains a fair quantity, and it is also present in some samples of arachis oil, rapeseed, palm kernel, and cottonseed oils contain little or none, and it is absent from olive and linseed oils and vegetable margarines Certain animal fats form much richer sources, most notably cod liver oil, it is also present in beef-suet and butter, but is absent from lard and hydrogenated animal fats

Calcification of the teeth and jaws is also greatly improved by whole milk and egg yolk, cabbage may have a slight effect, but no calcifying vitamin was detected in carrot, and extensive experiments showed that protein, such as meat protein, caseinogen, eggwhite or legumes, carbohydrate, such as glucose or a diastatic digest of a cereal, lemon juice (as a rich source of vitamin C) and yeast (as a rich source of vitamin B) had no influence in improving the structure of the teeth of puppies on the basal diet

Mammalian liver fat, which contains abundant vitamin A, had little effect on calcification, complementary to this result is the more recent finding that irradiated ergosterol, a source of vitamin D unmixed with vitamin A, exerts an extremely powerful influence upon the calcification of the teeth

Vitamin D was found to be destroyed by prolonged exposure to heat with simultaneous oxygenation of the fat containing it, the actual conditions necessary depending on the fat treated, at the same time some evidence was obtained that harmful products were actually produced by this treatment in cod-liver oil and butter Methylation of cod-liver oil also resulted in considerable destruction

Since the hardness of bones and teeth is due to their content of calcium and phosphorus deposited as inorganic salts in the original organic matrix, it is clear that the diet must contain both these elements if calcification is to proceed normally The experiments of Mrs. Mellanby have indicated, however, that the amount of each present in the diet and the Ca P ratio are of little significance in promoting or hindering calcification as compared with the intake of vitamin D In the rat, on the other hand, rickets cannot be produced unless the Ca P ratio is high In puppies, when vitamin D is abundant in the diet, perfect calcification of the teeth occurs even when the calcium intake is very low, on the other hand, when the vitamin D intake is moderate or low, addition of a calcium salt, such as the carbonate or phosphate, results in definite improvement of calcification Thus butter containing moderate amounts of vitamin D is more effective as a calcifying agent when separated milk is added to the diet, the latter acting as a source of calcium, and butterfat which contains no calcium is less efficient than butter The effect of the addition of calcium depends not only on the absolute vitamin D intake, but also on that relative to the nature of the cereal in the diet

One of the most interesting results obtained in the course of the work is the fact that varying the nature of the cereal in the diet, all other constituents being the same, also varies the degree of calcification of the bones and teeth With oatmeal as the cereal the structure of the teeth is the most defective, with white flour the least, other cereals lie between these two in the potency of their anti-calcifying effect, in order, other preparations of oats, rye, barley, maize, the germ of wheat and maize, wholemeal flour and rice, bran has no influence, whilst rye germ exerts a positive calcifying effect Examination of the various constituents of oatmeal showed that the anti calcifying factor was not the fat or the protein, although it might in part accompany these constituents when extracted, nor was it related to the carbohydrate, nucleic acid, or calcium and phosphorus content, or to the acid base ratio of the cereal Rye germ, as well as ergot of rye, were shown to contain small quantities of vitamin D, after the fat had been extracted from the former, and with it the vitamin, the residue had a definite anti calcifying influence Destruction of this factor occurred on heating the cereal with 1 per cent hydrochloric acid or caustic soda for 1½ hours, heating alone had little effect Malting also resulted in some destruction, provided the germinated cereal was allowed to stand for a few days before consumption

Since the cereal forms the chief energy producing constituent of the diet, varying its amount in the diet varies also the number of calories available, and within limits, the growth rate of the puppy On the same diet more rapidly growing animals have worse calcified teeth than those growing more slowly, hence, to obtain comparable results, it is necessary to limit the food consumption of a series of animals to that of the one with the smallest appetite

Experiments on the influence of environment on tooth calcification indicated that confinement played no part, the important factor in this connexion is exposure to sunshine Similarly, irradiation of the animal by a mercury-vapour lamp resulted in improved calcification, but under the

conditions used was not so effective as adding cod-liver oil to the diet, irradiation of various food materials also improved their calcifying action for example, olive oil, butterfat, oatmeal, and maize germ, due to the production of vitamin D from the ergosterol present in them, as was to be expected, even small amounts of irradiated ergo sterol can give nearly perfect calcification

Vitamin D can be stored in the body, hence offspring from a mother well supplied with it show greater resistance to an imperfect diet than young from a mother kept herself on this diet, evidence was obtained that the mother supplies the young from her own stores when her intake is deficient The structure of a tooth is permanent, so that variations in the diet at different periods will be reflected in variations in its structure, in contra distinction, imperfectly calcified bone will be re absorbed when the diet is improved Improvement of a bad diet will be reflected immediately in improved calcification of the later-formed dentine, but a change from a good to a bad diet will have little immediate effect owing to the avail ability of the body's stores of vitamin D

The work here presented proves convincingly that the structure of the teeth of puppies depends almost entirely upon the intake of vitamin D Even although the diet given was soft and pappy, perfectly formed teeth and well-developed jaws were produced, provided a sufficiency of the vitamin was given Exercise of the jaws appears to depend upon the general health, giving an animal some thing hard to gnaw will not produce well developed jaws when the vitamin intake is low

The application of these results to man and the relationship of structure to dental disease will form the subjects of Parts II and III of Mrs Mellanby's reports Considering that rickets occurs in both man and the dog, it might be expected that diet would have an influence upon the structure of human teeth Caries of the teeth, however, does not occur in the latter, so that a relationship be tween this disease and structure must be deter mined in other animals or in man himself Some evidence of such a relationship has already been published (see, for example, the *British Dental Journal*, 1928, July 15), the final reports will be awaited with interest, owing to the importance of such a conclusion for the prevention of human dental disease

Obituary

Prof Augustine Henry

Augustine Henry was born on July 2, 1857, coming of an old Derry family, and possessing to the full the delightful characteristics of the Irish race He was educated at Queen's College, Galway and Belfast, and was trained as a medical man, being L R C P, Edinburgh He began his career as an attached medical officer of the Chinese Imperial Customs at Shanghai In 1882 he was appointed in this capacity to the Customs Station at Ichang on the Yangtze, where he remained for seven years Here he commenced to interest himself in the flora, following in the footsteps of earlier medical officers in India, such as Wallich, Falconer, Cleghorn, Hooker, etc As with these officers, it was doubtless the medicinal possibilities of the many unknown plants which aroused Henry's interest at the outset Even more than in India, China is the home of the *materia medica*, the great therapeutic value of many bulbs, roots, and leaves of common plants being known to the Chinese The legendary Emperor, Chennung, was, so tradition has it, a great exponent of the medicinal values of plants So keen was this interest that it is said that Chennung had a glass window fitted into the wall of his stomach in order to study the reactions of different plants on the alimentary system! Henry will be remembered in horticultural circles as the introducer of the beautiful *Lilium Henryi* and many other Chinese plants

It was during his sojourn at Ichang that Henry commenced his explorations and investigations into the flora, and thus became the first of a select band of adventurous spirits who investigated the flora of central and western China One predecessor there had been, Robert Fortune, who first went to China in 1842 to collect plants for the Royal Horticultural Society, and afterwards, in 1848, on behalf of the East India Company, introduced the tea plant into India But Fortune's work was carried on in other parts of China Henry's collections were chiefly of dried plants, and he wisely sent those first made to Kew, where they were received by Thiselton Dyer with high appreciation for their examination soon showed that a new flora was being tapped For example, the collections from Hupeh (made in 1888), a botanically unexplored country, were found to contain 500 new species of plants and 20 new genera It was here that Henry came across the flowering tree *Davidia* This is now well known in Great Britain, but the seed was not sent home by Henry Veitch, of Chelsea, sent out E H Wilson, who afterwards became famous for his collecting work, and the latter obtained the seed

After a year's leave at home, where Henry found himself eagerly welcomed in botanical circles, he returned to Shanghai, and was soon transferred to Formosa (which had not then been made over to Japan) During three years spent there he collected assiduously and greatly enriched our knowledge of Formosan plants, publishing later a first account of the flora of Formosa Henry had for some time previously ceased to practise medicine In 1896, Sir Robert Hart transferred him to Mengtse in southern Yunnan In this region he collected extensively, and sent home large collections containing many new species He discovered the wild tea plant whilst exploring the virgin forests in the mountains south of the Red River in south-east Yunnan This plant had not previously been discovered out of Assam He was afterwards stationed at Szemao, where his

inexhaustible energy resulted in collections of equally rare and interesting plants

During his numerous explorations Henry's interest had been aroused in trees and in the forests When he finally returned home in 1900, after having accomplished what would have satisfied many men as a life's work, he therefore determined to study forestry For this purpose, being then forty five years old, he joined the French Forestry School at Nancy, where he passed nearly two years, 1902–3 It was in the latter year that, being on furlough, I accompanied the senior class of that school on a tour of the Vosges and first met Henry, who formed one of the class To those who knew that delightful personality, it will be unnecessary to say that Henry was the life and soul of the party, and his quaint Irishisms and anecdotes, rendered into French with a rich Irish brogue, were an unfailing source of merriment

In connexion with his forest work, Henry will be chiefly remembered for his collaboration with the late H J Elwes in producing the great standard work on "The Trees of Great Britain and Ireland", which was published in parts between 1906 and 1913

It was whilst engaged on this work that Henry was appointed to the first readership in forestry founded in 1907 in the new School of Forestry at Cambridge From that appointment he started a second life's work At Cambridge he was chiefly interested in carrying out breeding experiments connected with trees, chiefly elms, on Mendelian lines—a piece of research work which, for some purposes, may have practical results In 1913, Henry was appointed professor of forestry in the College of Science, Dublin, the chair being afterwards absorbed (in 1926) in the Irish National University In addition to the "Trees of Great Britain" he published "Forests and Trees in Relation to Hygiene", and many papers in the *Kew Bulletin* and other scientific publications His travels, apart from China, in the forests of North America and a considerable portion of Europe, gave him an intimate knowledge of the species of trees of many types, a knowledge which was ever at the disposal of all

Henry had a wide circle of friends in many walks of life, and many will remember the kindly face, great energy, and ever ready humour which rendered so many excursions of the Royal Arboricultural Societies the more enjoyable for his company E P STEBBING

PROF F V THEOBALD

FREDERICK VINCENT THEOBALD died on Thursday, Mar 6, at his residence, Wye Court, Wye, Kent, at sixty-one years of age Though a comparatively young man, he had not had good health for some time, being very susceptible to chills Last Easter he made a marvellous recovery from pneumonia, but it undoubtedly left its mark in the form of a weakened heart Some six weeks ago, when about to leave the house for a much-needed change, he became ill and was ordered to bed He seemed to be progressing satisfactorily when bronchitis set in, and this in his weakened state led to his death

The son of the late J P Theobald of Kingston-upon Thames, Theobald's early days were passed at his home and at St Leonards He then went to St John's College, Cambridge From a very early age he was attracted to all forms of Nature study, and at the early age of eight, with childish enthusiasm, he set himself the task of writing the "Fauna of Sussex" The pages in a boyish hand writing showed such promise that his parents deemed them worthy of binding, and they form an interesting first volume to his many subsequent works

Of Theobald's later entomological work much could be written After taking his degree he became an extension lecturer in economic zoology for the University of Cambridge, but on the opening of the South Eastern Agricultural College in 1894 he gave this up, taking up the post of lecturer in agricultural zoology at Wye

Besides the many reports of economic entomology which have appeared from Theobald's pen, he published 'Agricultural Zoology", a standard text book, and "Insect Pests of Fruit", a large reference work which soon found favour amongst the fruit growers not only of Kent but also of Britain generally About this time he was also engaged upon work on mosquitoes, and having completed his 'Monograph of the Mosquitoes of the World", he turned his attention to the Aphidæ This was some twenty years ago, and although the third and last volume of his monograph on the "Plant Lice or Aphidæ of Great Britain" appeared a year ago, he was still at work upon the group at the time of his death

Among the numerous scientific distinctions which came Theobald's way were the election to honorary membership of the Société nationale d'Acclimatation de France, from which he received the Grande Médaille Isidore Geoffroy Saint Hilaire, Société pour l'Étude Agriculturale Zoologique de Bordeaux, Société de Medicine tropicale de Paris, Association of Economic Entomologists of the United States, and the Royal Horticultural Society of Britain, etc He was made an Officer of the Imperial Ottoman Order of the Osmanieh, he was also a Mary Kingsley medallist (University of Liverpool) and a fellow of the Entomological Society of London, only a few years ago he was presented with the Victoria gold medal of honour of the Royal Horticultural Society He was also an early president of the Society of Economic Biologists, and at one time was vice-principal of the South-Eastern Agricultural College

From 1900 to 1904 Theobald was entrusted with the arrangement of the economic zoology collection at the British Museum and resigned his agricultural zoology professorship in the University of London In 1920 he ceased to hold the post of lecturer at Wye College, devoting his time to advisory and research work under the Ministry of Agriculture, and though this work was primarily for the south-eastern province of England, he had much correspondence from other parts of the world

Theobald was not a collector in the ordinary sense of the word, and was always against the formation of mere collections of dried insects, he got together, however, what is probably the finest collection in existence of insects of economic importance, showing the various stages and damage done by these pests In his work he may at times have appeared too hasty in his summing up of obscure matters and so opened himself to criticism, but in time his critics were usually compelled to come round to his way of thinking

Of a kindly and genial nature, Theobald was always more than ready to help with advice those who came to him for assistance, and the present writer, who had the privilege of being in close touch with him for nineteen years, will always be grateful to him for his ever-ready help He was buried in Wye Churchyard on Monday, Mar 10, being borne from the house by colleagues and students of the College to which he had given so much of his time C A W D

We regret to announce the death in his sixty-second year of Prof Robert Franz Pschorr, which occurred quite unexpectedly on Feb 23 in Munich Prof Pschorr occupied the chair of organic chemistry at the Technical High School in Charlottenburg From the *Chemiker Zeitung* we learn the following particulars of his career Born and educated in Munich, he began the study of chemistry there under Adolph von Baeyer Part of his student course was also spent with Bamberger at Zurich and with Knorr at Jena, where he graduated in 1893 Attracted to Berlin by Emil Fischer, he began there his well known work on the synthesis of derivatives of phenanthrene, which at once established his reputation Thereafter Pschorr's chief interest lay in the investigation of the constitution of the alkaloids derived from phenanthrene Shortly after his arrival in Berlin, Pschorr was appointed to a responsible position in the University Chemical Institute, and in 1914 he was elected to succeed Liebermann at Charlottenburg During his later years he devoted considerable attention to the investigation of coal-tar He interested himself greatly in the student-life of Berlin, and became the first president of the students' hostel at Charlottenburg He was the recipient of many academic honours, and was one of the editors of the *Berichte der deutschen chemischen Gesellschaft*

We regret to announce the following deaths

Prof G A Gibson, emeritus professor of mathematics in the University of Glasgow, aged seventy one years

M Armand Solvay, president of the Société Solvay, and honorary member of the Society of Chemical Industry, who was the son of Ernest Solvay, the pioneer of the ammonia soda process, on Feb 2, aged sixty three years

Dr J W L Spence, who was associated with Rontgen in his early investigation of X rays, and was one of the founders of the Radiological Department of Edinburgh Infirmary, on Mar 15

Sir David Wilson, Bart, honorary treasurer and formerly chairman of directors and convener of the science committee of the Highland and Agricultural Society of Scotland, on Mar 8, aged seventy four years

News and Views.

Mr Richard Inwards, pioneer in mining and related operations in various parts of the world celebrates his ninetieth birthday on April 22, an event the more auspicious in view of his maintenance of personal vigour Born at Houghton Regis and educated at Soulbury, Mr Inwards early engaged in and afterwards adopted as a career mining prospection work, allied also with managerial duties He has reported on mining enterprises in Great Britain, Norway, Portugal, Austria, South America, and Mexico, indeed we think he has an even wider range of countries to his credit Elected president of the Royal Meteorological Society in 1894, Mr Inwards served for two years, his presidential addresses were entitled respectively, "Some Phenomena of the Upper Air", and "Weather Fallacies" He was also author of an interesting paper "Turner's Representations of Lightning", showing that the artist's representations might be placed side by side with photographs of lightning, and would be found to convey faithfully to the mind all that the highest powers of sight can perceive in the phenomena Mr Inwards once wrote regarding popular weather prophets "The stock-in trade of a prophet is of a slender and cheap description He must have an inventive mind, a store of self-confidence, a keen memory for successes, and a prompt forgetfulness of failures" Mr Inwards has been a fellow of the Royal Astronomical Society for many years

Classical education, as a contribution to general culture of the mind, is by no means to be held in small repute by those whose training has directed them into scientific channels of thought We sympathise with the view that everyone, including the scientific worker, has much to learn from the classics, and here we evidently have the support of the Archbishop of York, who discussed the matter in his presidential address to the Classical Association on "The Distinctive Excellencies of Greek and Latin" To look back on to a past age, to examine and to assimilate something of the spirit of the sources of our present day civilisation, is a delight and a profitable recreation such as we could wish all members of the scientific professions to enjoy, for the distinctive excellencies of Greek and Latin are unquestionable In so far as there are schools whence youth passes out into the world primed with scientific facts and figures but ignorant almost of the very existence of ancient civilisations, we would support the claims of the humanities—literature, history, philosophy—to recognition, but we would also remind Dr. Temple that there are places where neither the plea nor the support is necessary, where it is the

scientific spirit that is being stifled in a stuffy atmosphere heavy with the odours of the past Dr Temple goes further than we can follow when he expresses alarm at the non classical educational trend of Great Britain There is nothing to get alarmed about in the spread of an honest search for knowledge, indeed, our feeling of alarm is reserved for the consequences of forgetting that the need of a scientific age is a scientific education

It is all very well to say that except for those who are to be specialists in the study or application of the natural sciences it is more important to know about European civilisation than to know about the solar system, but the inference that the advance of civilisation is not very closely dependent on the progress of science is one which few students of mankind will admit It is no doubt also very true to say that the most important of any human being's relationships are those between himself and his God, and those between himself and his neighbours There is, however, no prohibition of the use of a more strictly theological term to express the scientific worker's 'ultimate cause', no monopoly of a sense of the wonder and power of which no one is more acutely aware than the student of science, whilst as for a man's relations with his neighbours, what better apprenticeship could he serve than that which demands of him exceptional patience and the strictest integrity, and encourages him to regard his fellows as members of an international fraternity? Does he think too highly of his ability, an hour's study of astronomy will convince him of his impotence Is he unaware of the powers that are at his command, chemistry, medicine, engineering will teach him more than will Greek and Latin Let him first learn his own language, learn to love it and learn to use it, then let him turn to foreign tongues, to such foreign tongues as are used to disclose man's mind to day Above all, let him remember that the quest of truth will outlast himself, his generation, even his civilisation, that his dreams, his arts and his literature, however beautiful, may be forgotten a thousand years hence when men are still building on the scientific foundations he has laid to day

Not very long ago the public, or at least that part of it which has any care for the beauties of the country side, was shocked at the ravages of quarrying operations at Malvern A project of a similar nature but even more serious in its consequences is contemplated in Northumberland It will affect five miles of the finest stretch of Hadrian's Wall A company is to be formed to quarry the whinsill dyke in the neighbourhood of Shields-on the-Wall, Pell Crag, and Housesteads The site of the projected quarries includes the finest and most characteristic of the Wall scenery About 200,000 tons of material will be removed annually, and eventually, it is estimated, 100,000,000 tons of whinstone will be taken away Although it is difficult to forecast the ultimate effect of its removal on the land surface, it is certain that the landscape will be completely transformed and the meaning of the Wall utterly obscured The relation to the surrounding country, which determined the siting of the Wall as a defensive work, will vanish with inestimable loss to the study of Roman culture and military science in Britain The Wall will be left on the edge of a high cliff and be quite inaccessible from the south, for in some places quarrying may proceed to a depth of as much as 400 ft The beautiful scenery thus to be obliterated includes land around the fort at Housesteads, the Borcovicus of Roman times, lately presented to the National Trust by Mr J M Clayton

A vigorous resolution of protest has been framed by the Council of the Society of Antiquaries of Newcastle on Tyne, but the proposal is a calamity which calls for nothing less than a national protest The Wall, like Stonehenge, is essentially a characteristic element in the history of British culture The magnitude of the financial interests involved should not be allowed to stand in the way of its safety and it should be saved as Stonehenge was saved in similar circumstances Hadrian's Wall has been scheduled as an 'ancient monument', but the existing law does not allow the surrounding countryside to be protected in this manner In a clash of historical and economic interests of this magnitude, pressure should come from the nation as a whole to secure that commercial considerations should give way and the law be amended to make it possible not only for the country adjoining the Wall and forming an integral part of the ancient line of defence to be declared a national park, but also that legal provisions should be so framed as to make any similar situation impossible in the future

As we have already announced, an exhibition of objects illustrating the culture of Zimbabwe opened in the Assyrian Basement of the British Museum on April 7 Among the chief contributors are the British Museum, the South African Museum of Cape Town, the Rhodesian Museum, Bulawayo, and the Queen Victoria Memorial Museum, Salisbury The recent excavations of Miss Caton Thompson at Zimbabwe and of Mr A L Armstrong at Bambata, preparatory to the visit of the British Association to South Africa, are well represented It is intended that the exhibition should afford material for comparison with objects of a similar character from other parts of Africa Among the most interesting objects shown are those of carved soapstone These include examples of the birds of prey, about two feet high, which originally formed the end ornaments of the perpendicular beams crowning the walls of the elliptical temple Four of these are shown with the stone pedestals of others which are decorated with various linear patterns—herring bone, basketry, chevrons, and lozenges A short soapstone cylinder decorated with 'rosettes' is thought by some to be a symbol of fertility Most remarkable for their decoration are the large flat soapstone trays, almost all of them broken in fragments On the exterior of the raised rims is carving in medium relief Sometimes this imitates the appearance of plaited grass trays of similar shape, sometimes it shows scenes of animal life, especially long horned cattle One of the most remarkable is a hunting scene in which the hunter and his dog, baboons, a bird, and zebra appear This was published in the *Times* of April 7, accompanying an article by Prof J L Myres, in which he summarised the results

of Miss Caton Thompson's work in their bearing on the problem of the origin and date of Zimbabwe

The Minister of Health, Mr Arthur Greenwood, announced in the House of Commons on April 9 that the committee on post graduate medical education, composed of fourteen leading physicians and surgeons appointed by his predecessor, Mr Neville Chamberlain, in July 1925, has issued a report recommending the establishment of a British Post Graduate Hospital and Medical School The possibility of converting the West London Hospital, which does not possess a medical school, had first been considered by the committee, but it was found that the capital cost of conversion and equipment would not be less than £400,000, while the cost of maintenance would be at least £100,000 a year exclusive of the medical school Moreover, the site, covering only 2½ acres, did not allow of any further expansion The hospital finally chosen was the Hammersmith Hospital in Ducane Road, built in 1905, containing 400 beds in modern wards, which was transferred from the now extinct Boards of Guardians to the London County Council on April 1 The hospital will continue to be supported by the rates, and the Government has decided to contribute from the public funds a sum of £250,000 for building and equipping a medical school as well as to provide grants for its maintenance through the University of London An appeal will shortly be made to the public for funds to establish a residential hostel in the centre of London for the use of students of both sexes, not only in medicine but also in other arts and sciences, from the Dominions and Colonies The Committee's report has been published by His Majesty's Stationery Office as a White Paper (*9d* net)

The Radium Commission has issued a statement on the progress of the national organisation which it is engaged in setting up The cardinal feature of the Commission's policy has been the concentration of national radium at a limited number of centres in England, Scotland, and Wales, where there are medical schools with complete clinical courses, and where treatment of patients can be combined with education in approved methods of radium therapy Of these centres 12 have already been nominated, and will be recognised as 'National Radium Centres' as soon as they have complied with the requirements of the Commission They are as follows —Birmingham, Bristol, Leeds, Liverpool, Manchester, Newcastle, Sheffield, Aberdeen, Dundee, Edinburgh, Glasgow, and Cardiff In every instance the channel of communication between the Commission and the centre is the medical faculty of the local university, and loans of radium are being restricted in each area to one hospital selected by the faculty By these means it should prove possible to avoid the dangers and futilities of splitting up the limited national stock of radium into small quantities, which would not only give ineffective results, but also contribute little, if anything, to a national controlled and co ordinated study and practice of radium therapy

London has been treated as a separate and special problem, in view of its position as the metropolis of the whole country Here no centre of the normal type is being set up, but steps have been taken to organise two centres to carry out special work of general and national importance One of these, the Westminster Hospital, has been experimenting, on behalf of the Commission, for several months past with a 'bomb' (containing 4 gm of radium), in order to determine the value of long-distance radium therapy The other London centre which is being organised by the Commission is one for the development of post graduate teaching in radium therapy—a prime and urgent need—and the facilities which will be provided will be available for the benefit of qualified medical practitioners from any part of Great Britain This centre will be located at the Radium Institute and the Mount Vernon Hospital (Northwood), which institutes for these purposes are being reorganised as a joint teaching centre styled the "Mount Vernon and Radium Institute", under a single control, so far as medical services, teaching, and research are concerned

Mr Henry Twitchin, who died at Nice on Mar 19, has left the whole of his property, with the exception of certain minor legacies, to the Eugenics Society The bequest is accompanied by no conditions, except that the capital is to remain intact Mr Twitchin, who came of an English farming family, settled in Western Australia, and came to own two large stations His attention was attracted to eugenics by his own personal experiences as a pastoralist, and probably by a belief that he himself suffered in health from hereditary defects He was, therefore, above all things anxious that eugenists should be practical in their aims, fully believing that we now know enough to advance safely in many directions He had for many years subscribed generously to the Eugenics Society, but insisted on remaining strictly anonymous His aim was to benefit mankind, without winning any notoriety for himself The value of the bequest is not yet known, but it will probably be not very far short of £100,000

An important contribution to the proposals which have recently been made for the reform of the British patent system is furnished in a memorandum issued by a joint chemical committee representing the Association of British Chemical Manufacturers, the Chemical Society, the Faraday Society, the Federal Council for Chemistry, the Institute of Chemistry, the Institution of Chemical Engineers, the Society of Chemical Industry and the Society of Dyers and Colourists The memorandum, like other similar documents of the past year or two, is based upon the report of the Patent Law Reform Committee of the British Science Guild, and is admirably drawn up The proposals are classified into 'major', 'minor', and 'controversial', the latter class comprising those in which the committee differs from the conclusions reached by the British Science Guild A valuable feature of the memorandum lies in the concrete suggestions which it puts forward for the amendment of various sections of the Patents Acts; it is distinctly advantageous to have a definite form of words

as a basis for discussion on such subjects Further, the memorandum supplements the Guild's proposals in respect of some matters, of special interest to chemists, which were somewhat overlooked in the parent report

AMONG the more important of the Joint Chemical Committee's recommendations the following may be mentioned (1) Extension of the Patent Office search to cover a wider field than at present, (2) restriction on the granting of 'selection patents', (3) extension of the Comptroller's judicial powers, by the introduction of a new ground of opposition ('no manner of manufacture'), (4) restrictions on 'user patents' and on unduly wide claims The memorandum does not favour the suggested introduction of 'short term patents' (*Gebrauchsmuster*), on the ground that these would hamper rather than encourage manufacturers The most interesting part of the memorandum, however, is that which deals with medical patents At present, medical ethics precludes the patenting of drugs and biochemical products which are of use in medicine, with the result that foreign patentees are able to exploit British discoveries to their own advantage, while British manufacturers may be deprived of the assurance of such reasonable return on their outlay as would enable them to put new products of high quality on the market at moderate prices The memorandum puts forward in considerable detail a scheme whereby medical patents may be dedicated to the State and administered by a 'Medical Patents Trustee' acting under the guidance of a suitably constituted advisory committee

SEVERAL reports have appeared in the press recently of a communication made on April 9 by Prof W B Harkins to the American Chemical Society, on the effect of collisions between α particles and nitrogen atoms It is not clear from these whether Prof Harkins has been describing new work, or whether he has merely given an account of the earlier researches made on this subject by him, some details of which have already been published In these, the cracks of α particles in nitrogen are observed by the cloud method of Prof C T R Wilson A very small proportion of the collisions between the nuclei of helium and of nitrogen result in the appearance of a new fast proton, and the formation of a fresh, heavy nucleus which is almost certainly that of an isotope of oxygen, since the α particle disappears Excellent photographs of this effect were obtained several years ago by Mr Blackett in the Cavendish Laboratory, and many investigations of it have been made during the last decade by other methods by Sir Ernest Rutherford and Dr Chadwick and others The advantage of the cloud method is that it gives fairly complete information about the fate of all the interacting particles in any particular collision Its great disadvantage is that it is extremely tedious, since reorganisation of the nitrogen nucleus happens so rarely that only about ten cases in which this has occurred have as yet been photographed, although of course many thousands of the protons ejected have been recorded by the method of scintillations and by the use of electrical counters The theory of the effect is now receiving the attention of physicists on the basis of the wave mechanics, and also, whereas it was thought at one time that oxygen was a pure element, it is now known from the evidence of band spectra that it does actually possess isotopes

AN inquiry into the teaching of Empire geography in schools is the subject of a report by the Board of Education (Educational Pamphlets, No 79) The inquiry showed that this aspect of geography is not being neglected in elementary and other schools visited It is stated that there is little evidence of that widespread ignorance in schools in Great Britain of the geography of the British Empire which has been alleged to exist, although there is room for improvement and progress There can be no doubt that most children on leaving school have a reasonable knowledge of the topography of the Empire, and the conditions of life in its different parts They also have some knowledge of the sources of authoritative information and some ability to interpret and apply that information The inquiry has suggested a doubt as to whether too much is not expected of the average child, and it is clear that the time available makes it impossible to give a detailed knowledge of particular parts of the Empire It is noted that the demand for specialists to teach the subject is increasing

THE annual report for the fiscal year ending June 30, 1929, of the Director of the Bureau of Standards (*Miscellaneous Publication*, No 102, Washington, D C Government Printing Office, 10 cents) is interesting and instructive During the past year there has been much correspondence and discussion relative to the question of defining the yard in terms of wave lengths of light The International Conference on Weights and Measures has agreed that the length of the metre is equivalent to 1553164 13 wave lengths of the red radiation from cadmium when produced under standard conditions The Bureau is anxious that the yard should be accepted as equal to 0 9144 metre or, which is the same thing, that the inch should be taken as exactly equal to 2 54 millimetres At the same time, it is highly desirable that industrial measures of length should have their nominal dimensions correct at a temperature of 68° F (20° C) If this were done, then, in the opinion of the Bureau, the problem of the international interchangeability of parts would be completely and satisfactorily solved The search for a source of homogeneous radiation has been renewed Since Michelson compared in 1893 the wave length of the red radiation of cadmium with the length of the international metre, no serious competitor to the red cadmium line has been forthcoming A line of krypton which was very narrow was tried, but proved unsatisfactory, as it lacked intensity and was subject to reversal Certain lines of krypton and xenon might usefully be employed as auxiliary standards, but they compare unfavourably with cadmium red Photo electric cells with a Riefler clock have proved useful for obtaining accurate time signals The signals for distribution to the Bureau's laboratories are correct to about 0 0001 sec

IT is stated in the annual report that the total expenditure of the United States Bureau of Standards for the year 1928–29 was £460,000, about 7 per cent less than the average of the two previous years Salaries amount to £117,000, cost of testing structural materials £45,000, of industrial research £32,000, of commercial aircraft research £25,000, and of research on the standardisation of mechanical appliances £33,000 The fee value of the commercial tests carried out for the State departments and for industry was £109,000 The staff consists of 365 regular members and about a hundred research associate members The average salary is £480 The *Journal of Research* published by the Bureau has now nearly six thousand subscribers

THE Right Hon Sir Samuel Hoare, Secretary of State for Air, 1922–29, has accepted nomination as president of the British Science Guild in succession to the Right Hon Lord Melchett

THE twentieth annual May lecture of the Institute of Metals will be given on Wednesday, May 7, by Major F A Freeth, who will take as his subject " The Influence of Technique on Research "

AT the annual meeting of the Société Nationale d'Acclimatation de France in Paris on April 6, Dr C Tate Regan, F R S , Director of the British Museum (Natural History), received the Isidore Geoffroy Saint-Hilaire medal for 1929

AT the meeting of the London Mathematical Society on May 15, at 5 P M , at Burlington House, Prof G I Taylor will deliver a lecture on " Recent Work on the Flow of Compressible Fluids " Members of other scientific societies who are interested are invited to attend

A ' FREDERICK G DONNAN FELLOWSHIP ' in Chemistry, open to graduates of the universities of Great Britain and Northern Ireland, has been founded at Johns Hopkins University, Baltimore, in honour of Prof Donnan, professor of general chemistry in the University of London Prof Donnan last year had the honorary degree of LL D conferred upon him by the Johns Hopkins University, and also the honorary degree of D Sc by Princeton University and Oberlin College He is to receive the honorary degree of D Sc from the University of Durham in June, and has this year been elected a foreign member of the Royal Society of Sciences, Uppsala

AT the annual meeting on Feb 3 of the Asiatic Society of Bengal, the Barclay Memorial Medal, which is awarded each alternate year to that person who, in the opinion of the Council, has made conspicuously important contributions to medical or biological science with reference to India, was awarded to Mr Albert Howard, director of the Institute of Plant Industry, Indore, and Agricultural Adviser to States in Central India The Joy Gobind Law Memorial Medal, which was instituted last year and is to be awarded every three years to that person who, in the opinion of the Council, has made conspicuously important contributions to our knowledge of zoology in Asia, was awarded to Prof Max Weber, emeritus professor of zoology in the University of Amsterdam, for his contributions to our knowledge of the fauna of Asia as director of the *Siboga* Expedition to the Malay Archipelago, and for his work on Indo-Malayan fishes

A PRELIMINARY programme has been issued of the Portsmouth Congress of the Royal Institute of Public Health to be held on June 4–9 The presidents of the five sections and the subjects of their respective addresses are as follow Prof H R Kenwood, the reduction of preventable diseases (Section I , State medicine and municipal hygiene), Surgeon Rear Admiral H C Whiteside, problems of the sea faring doctor (Section II , naval, military and air, including tropical diseases), Sir Thomas Oliver, the health of the modern worker (Section III , industrial hygiene), Lady Keyes, the voluntary worker in public health service (Section IV , women and children and the public health), Sir Henry Gauvain, sun treatment in England (Section V , tuberculosis) Several discussions have been arranged and numerous papers are promised Particulars of the Congress can be obtained from the secretary of the Institute, 37 Russell Square, London, W C 1

WITH reference to the classified list of Nobel Prize Awards, published in NATURE of April 5, Prof M W Beyerinck, writing from Gorssel, Deventer, Holland, recalls that during the period of Prof van 't Hoff's prime contributions in connexion with the discovery of the laws of chemical dynamics and osmotic pressure in solutions, for which he was awarded the Nobel Prize in Chemistry for 1901 (the first allocated in the section), he was a professor in Amsterdam, and not in Berlin Van 't Hoff was at the University of Amsterdam from 1878 until 1896, and his collected " Études de dynamique chimique " appeared in 1884, and the celebrated paper on " The Laws of Chemical Equilibrium in the Dilute, Gaseous or Dissolved State of Matter " in 1886 He removed to Berlin in 1896, and passed the remainder of his life in Germany hence Germany was his " working domicile at the time of allotment of the prize ", although, of course, Holland was the scene of the fundamental researches for which the prize was awarded It is desirable also to correct here a mistake in classifying under France the award of the Physics Prize for 1909 to Prof Ferdinand Braun (Strasbourg) Dr von Auwers, Berlin-Siemenstadt, writes to point out that in 1909, Strasbourg and its university were German and not French Prof Braun's name should, therefore, have appeared with the prize awards under Germany

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A lecturer in geology at University College, Grahamstown, South Africa—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W C 2 (April 25) Full-time teachers at the Technical College and Junior Technical School, Horwich, one mainly for science or mathematics in the Junior Technical School for Engineering Subjects in the College , and one for wood and metal work, and mechanical drawing in day and evening classes—The Secretary, Railway Mechanics' Institute, Horwich (April 26) A research student at St Mary's Hospital, Institute of Pathology and Research—The Secretary, Institute of Pathology and Research, St Mary's Hospital, Paddington, W.2

(April 28) A senior lecturer in applied mathematics in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (April 30). A first assistant in the clinical laboratory of the Manchester Royal Infirmary—The General Superintendent and Secretary, Royal Infirmary, Manchester (April 30). A full time assistant master in the Junior Technical School and Evening Technical Classes of the Worsley Technical School, near Manchester—The Secretary for Higher Education, Town Hall, Walkden (May 1). Readers, (a) economics, with special reference to banking and currency, (b) economics, with special reference to industrial organisation, and (c) international history, at the London School of Economics—The Academic Registrar, University of London, S.W.7 (May 1). A technical assistant in the department of the Chief Officer of the London Fire Brigade for inspectorial and advisory duties connected with fire and safety matters in buildings licensed by the London County Council for public entertainment—The Clerk of the London County Council, The County Hall, Westminster Bridge, S.E.1 (May 5). A woman demonstrator in pathology at the London (Royal Free Hospital) School of Medicine for Women and Royal Free Hospital—The Warden and Secretary, 8 Hunter Street, W.C.1, or the Secretary, Royal Free Hospital, W.C.1 (May 6). An assistant medical secretary of the British Medical Association—The Medical Secretary, British Medical Association, Tavistock Square, W.C.1 (May 12). A soil chemist in the department of agriculture, Kenya—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (May 15). A professor of mechanical engineering at the Bengal Engineering College, Sibpur, Bengal—The Secretary to the High Commissioner for India, General Department, India House, Aldwych, W.C.2 (May 19). A laboratory assistant for the medical department of Kenya Colony—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/2117).

Our Astronomical Column

Recent Magnetic Disturbances.—A magnetic disturbance with a range in declination of 30′ was registered at Greenwich between April 6 and 9. There was no definite commencement, which may be taken as occurring about 18h on April 6. The greatest range in declination was registered on April 7–8. This is the third member of a sequence of three small storms which have taken place at intervals of about a solar synodic rotation. The dates of the two preceding storms are Mar. 11–18 (commencement Mar. 11.6) and Feb. 12–16 (commencement Feb. 12.9). No unusual solar disturbance was observed on any of the above dates, but cloudy weather in England rendered observing impossible on most days just before and during each magnetic storm. It may be noted, however, that a fair sized sunspot in latitude 17° N. crossed the sun's central meridian on April 7.1.

Distance of the Trans-Neptunian Planet.—Prof. G. Armellini, Capitol Observatory, Rome, writing with reference to the distance of the Trans-Neptunian planet, reminds us that in 1918 he published in *Scientia* (vol. 24) a simple relation between the distances of the planets from the sun. This relation is given by the formula $D = 1.53^n$, where $n = -2$ for Mercury, -1 for Venus, 0 for the earth, 1 for Mars, etc. For the Trans-Neptunian planet, $D = 1.53^9 = 45.6$. The distance calculated by Bode's law is 77.2, and by Bélot's law (*Comptes rendus*, II. p. 937, 1905) is 61. Prof. Armellini regards the true distance as probably between 45 and 48, and his value agrees with this estimate. We do not, however, know the distance of the new planet yet. Assuming a circular orbit, the distance comes out close to 40, but it is probably an ellipse, and a much longer interval is required to determine its elements.

Photo-electric Observations at Neubabelsberg.—*Astr. Nach.*, No. 5683, contains a paper on these observations by Margarete Gussow. The most interesting of the stars the light changes of which were investigated is Boss 46. This is one of the very massive stars, of type *O*, the radial velocities of which have been studied at the Victoria Observatory. It was found by Prof. Guthnick in 1919 that the star has a small variation of light, the full period of variation is 3.52 days, but this contains two unequal maxima and two minima. A paper by J. A. Pearce in vol. 3 of the Victoria publications discussed both the photometric and spectroscopic data: he showed that the system consisted of two enormous stars, the diameters of which are 23.8 and 15.5 times that of the sun, their masses being 36.3 and 33.8 times the sun's. They revolve nearly in contact with each other, and their shapes differ sensibly from spheres in consequence of tidal distortion, the eclipses are only small partial ones, and would scarcely have been detected without the photo-electric cell, the light range being 0.17 mag. Their detection enables accurate deductions to be made of the masses, diameters, and relative surface brightness of the components. These deductions are of use in making probable assumptions regarding the elements of the Plaskett star, B.D. +6° 1309. This is still more massive, but no eclipses have so far been detected. The light curve of Boss 46 appears to show progressive change since 1919, the two maxima having become more nearly equal; this might be explained by a motion of the line of apsides, which would undoubtedly be present. ζ Geminorum is another of the stars discussed in the paper; the light range is more than 0.6 mag., the period being 10.15 days; the colour index is found to change by 0.2 mag. in the same period, being 0.47 mag. at light maximum, and 0.66 mag. about a day before light minimum. α Canum Ven. was also examined; the observations in 1927 showed a regular light variation in the spectroscopic period of 5.47 days; the light range is less than 0.05 mag.: the variation is less clearly shown in the observations of 1928, 1929.

Annuaire Astronomique et Météorologique Camille Flammarion pour 1930.—This publication (printed by Jouve et Cie, Paris, published by Juvisy Observatory, Seine et Oise, 12 francs) contains all the usual almanac matter relating to the positions of sun, moon, planets, etc., with several other features likely to help amateur observers. There is a very full table of the elements of the periodic comets prepared by M. F. Baldet, also tables of double stars, variable stars, stars of large proper motion, etc. There are also sections on magnetism and meteorology, a table for the date of Easter up to the year 2200 is of course based on the assumption that no change will be made in the method of computation. The hints on choice of a telescope and methods of observing should be helpful to beginners. The work is edited by M. Ernest Flammarion.

Research Items

White Immigrants in Polynesian Tradition.—Mr. W. Ivens, in *Man* for March, discusses a number of traditions relating to white beings which occur in various parts of the Pacific. Malekula, New Hebrides, is said once to have been inhabited by a race called Ambat, who were white, and when Europeans first arrived on the island, they were believed to belong to that race and called by the same name. The Maoris believed in the existence of a white race of *atua*, and on Motu Island, Banks group, Bishop Selwyn and Bishop Patteson were taken for Kwat, the legendary hero: the origin of the association possibly being that he may have been supposed to be white. On North Mala, Solomon Islands, immigrants, white in colour, are said to have arrived in outrigger canoes at a place called Suuna Rii. They wore clothes and coverings to conceal their hair. Their hair was red, but for anyone to see it meant death at their hands. No name is given them, but they are accredited with the introduction of fighting, of magic, and of food plants, including the areca nut. They are worshipped on North Mala as *agalo i mae*, ghosts of war. The head covering of the *agalo i mae* survives in the pigtail of the statues of south-east Solomons, and the carved figures on Vanua Leva, Banks Islands, have a decided pigtail. In the Paumotus and Tahiti there are traditions of red-headed women who rose up from the floor of the lagoon. If, as seems possible, any connexion is to be seen between all these legends, the people to whom they relate may represent a movement into the Pacific at a very early date.

Neolithic Camps.—In *Antiquity* for March, Mr. E. Cecil Curwen, writing on neolithic camps, points out that while the popular attribution of prehistoric hill-forts either to the Stone age or the Roman occupation is usually erroneous, progress in prehistoric research in Britain during the last two decades has justified the popular belief in the existence of neolithic camps, though not in the specific instances expected. Among the neolithic camps described, special importance attaches to the account of Windmill Hill, near Avebury, which is based upon material supplied by Mr. Keiller, by whom the site has been explored annually since 1925, though his own reports are not yet published. The camp consisted of three rings of not quite concentric ditches, in most cases accompanied by ramparts on the inner sides. All these ditches are interrupted by numerous causeways. The outstanding value of this site lies in the stratification of the finds. British neolithic camps have certain very definite features, not all, however, exclusive to that period. Most obvious is the tendency for the ditches to be interrupted by causeways. It is suggested that these may have been intended to enable the defenders to sally forth at frequent points along the line of defence. There is also a tendency to concentric lines of defence with neutral ground between—not exclusively neolithic, but if one of the outer rings is fragmentary the presumption is strengthened. In some cases the defences are deficient altogether where the hill falls away steeply. The ground plan varies, but if one is more common than any it is the oval unrelated to the contour of the ground. The situation varies, the majority being on hill tops—but low-lying sites occur as at Abingdon. Of the hill forts some, curiously, are situated on a saddle between two eminences. In the consideration of the pottery, it is suggested that in the so-called Windmill Hill class two sources of influence are to be discerned, one from Portugal and Brittany, and one from Sweden and Norway.

Mammals of Uruguay.—The report on the collection made by the Captain Marshall Field Expedition during four months in 1926 and 1927 is made the basis of a complete list of Uruguayan land mammals by Colin C. Sanborn (*Field Mus. Nat. Hist.*, Publ. 265, 1929). The introduction mentions that the expedition collected 345 mammals, representing thirty species, but it does not even mention the total number of forms now recorded from Uruguay (they appear to be 53 or 54), and says not a word about the relationship of the mammalian fauna as a whole. We note, however, that three introduced European animals, the house mouse, the Norway rat, and the common hare, have become amongst the commonest and most destructive rodents in Uruguay—another lesson, if one be needed, on the danger of unconsidered importations.

Genetics of Interspecific Hybrid Birds.—Although many interspecific, intergeneric, and interfamilial crosses can be made between gallinaceous birds, such as turkey and guinea fowl, common fowl and guinea fowl, *Gallus bankiva* and *G. varius* and various pheasants, yet the frequent complete sterility of the F_1 prevents further breeding experiments which would determine their genetic composition. Serebrovsky (*Jour. Genetics*, vol. 21, No. 3) shows that it is possible nevertheless to draw important conclusions regarding the genotypic constitution of various species, from a study of the characters shown by the F_1 hybrids in crosses with different breeds of domestic fowls having various dominant or recessive characters which have probably arisen by mutation. From a study of such hybrid specimens in the museums at Hamburg and Berlin, he finds that such factors as bare neck, dominant white, melanism, and leg feathering, which are dominant in crosses between different breeds of fowls, are also dominant in the hybrids between fowls and various other genera of wild Gallinaceæ, Phasianidæ, and Tetraidæ. By the use of this method it should be possible to arrive at definite conclusions concerning the part played by mutations in the process of specific differentiation among these birds.

Dragon-Flies of the Family Cordulegasteridæ.—Owing to post-War difficulties attending the publication of the well-known series of memoirs entitled "Collections Zoologiques du Baron Edm. de Selys Longchamps", the issue of further fascicles of that work has had to remain in abeyance. The parts dealing with the dragon flies were never completed and Lieut.-Col. F. C. Fraser has aimed at their continuation. In *Memoirs of the Indian Museum*, vol. 9, part 3, 1929, pp. 69-167, he has contributed an important revisional monograph of the family Cordulegasteridæ. This paper forms Part 1 of a general revision of the whole group of the Fissilabioidea: its two remaining families, the Petaluridæ and Petaliidæ, it is mentioned, will form the subject of a subsequent contribution by Dr. R. J. Tillyard. The Zoological Survey of India is to be congratulated on having undertaken the work of publication, as a considerable part of the fauna dealt with occurs within the limits of the Indian Empire. The family under consideration comprises four genera and forty-five species and subspecies. These are fully described and figured in the present memoir, which forms a useful and complete account of the insects concerned.

Nutrition of the *Grantia* Amphiblastula.—Prof. J. B. Gatenby and Dr. S. D. King (*Jour. R. Micr. Soc.*,

Dec 1929) state that in well fixed preparations of *Grantia compressa* with amphiblastula larvæ there are near the larva a number of wandering cells, apparently amœbocytes In a later stage these cells become more numerous either by division or by the wandering in of others, and still later these cells form a wall round the amphiblastula Sometimes the wall or sheath is complete, but in other cases there are gaps The cells of this sheath are of two kinds—non granular cells which abut against the flagellated layer of the amphiblastula and granular cells against the posterior granular cells of the larva These latter cells contain osmiophile granules and ' there can be no doubt that these membranes form a sort of placenta between the mother sponge and the larvæ "

Polychæta of Lake Baikal—B Dybowski (*Bull Internat Acad Polon Sci Lettres* Ser B 2 Oct Dec 1929) criticises the memoir of Zenkewitsch (1925) on the fresh water Polychætes of Lake Baikal and dissents from the latter author's view that the fauna is to be regarded as a primitive fresh water fauna The generic characters of the fresh water polychætes *Manayunkia* Leidy, *Haplobranchus* Bourne, and *Dybowscella* Nusbaum are reviewed and two new genera established—*Trichosobranchella* and *Garjaiewella* The last four of these genera are represented each by a single species in Lake Baikal To merge these genera with Manayunkia is undesirable The author recalls with justifiable satisfaction his finding in April 1870 of the trochophore larvæ for the first time in Lake Baikal and adds a few other details of historical interest

Manurial Experiments on Fruit Trees—Mr T Wallace continues the description of these valuable experiments in the *Journal of Pomology*, vol 8, part 1, January 1930 The trees are grown in pots in sand cultures and their behaviour in complete nutrient solutions compared with their behaviour when the nutrient supplied is deficient in either potassium, magnesium, or calcium In this present paper, very full ash analyses of the pruned shoots over a period of three years are given Characteristic effects were produced by the omission of each element Potassium deficiency led to increased shoot growth, leaf scorch, and defoliation of shoots from tip to base Calcium and magnesium omission both led to reduction of shoot growth after the first season and to severe breakdown of leaf tissue The results of magnesium deficiency were especially severe and were reflected in a much lower percentage of dry matter on fresh weight, and thus possibly to a high percentage of ash on dry matter, the calcium and potassium omission series showed a reverse effect—a relatively high dry weight, and low ash content on dry weight Mr Wallace directs attention to the wide variations in the ash constituents in the bark and wood of shoots and main stems The ash is relatively uniform in the bark from both shoot and main stems, but the percentage of ash in the one year shoots is approximately twice as high as in the wood of the four year old stems

Arctic Ice in 1929—The Danish Meteorological Institute has issued the report on the state of the ice in the Arctic seas in 1929 In many respects the distribution was abnormal In the Barents Sea the pack ice was unusually far south in spring, and during April its edge was only 86 miles from the North Cape A few icebergs were close to the Murman coast in May, and throughout the summer, icebergs were seen in the Barents Sea On the west of Spitsbergen there was much ice in May and June In July it decreased, but in August some still remained The east coast was blocked throughout the summer The Spitsbergen ice had a more southern connexion with the east Greenland ice than is usual Along the east coast of Greenland, however, the pack ice formed only a narrow belt, though it extended to Iceland in July and August, there was exceptionally little on the south east coast In Davis Strait and Baffin Bay there was much less ice than usual The Kara Sea was open in August, September, and October The White Sea was blocked with heavy ice until the end of May On the Siberian coast and among the islands of the Canadian Archipelago the conditions were about normal Wrangel Island was accessible in September The report is illustrated with the usual charts and is written in English

Soil Erosion in Tanganyika Territory—Dr E O Teale describes the soil and agricultural development of parts of Northern Kigoma and Southern Bukoba Provinces in *Short Paper* No 4 of the Geological Survey of Tanganyika Territory The questions of soil erosion and conditions for re afforestation are particularly emphasised, for they seriously affect the future prosperity of an otherwise well favoured district The whole of the Kasulu Highlands were formerly covered with forest, but now there are widespread areas of wind swept, torrent cut, and eroded slopes due to the combined application of the axe and annual firing All that was needed to start the rapid disappearance of soil was deforestation Moreover, the custom of farming an area for a few seasons and then deserting it for a new block of virgin land favours the waste that is going on Hillside terracing such as is effectively adopted in southern Europe is not a practicable solution, for there is no local stone and the population is thin Dr Teale shows that, if the future is to be safeguarded, afforestation should be started and maintained by protecting certain selected areas from fire, and headward erosion of streams should be delayed by planting bamboos and native figs at the heads of runnels and gutters which threaten the still unbroken ground of the gentle slopes above them The geological features of the areas considered are described in the paper

Seismic Waves and the Sedimentary Layer—According to T Matuzawa (*Bull Earthquake Research Inst*, Tokyo, Sept 1929, p 257) the crust in the Kwanto district of Japan is made up of three layers (*a*) The upper or granite layer 20 km thick, $Pg = 5\ 0$ km/sec, $Sg = 3\ 15$ km/sec, (*b*) The second or 'intermediate' layer 30 km thick, $P^* = 6\ 2$, $S^* = 3\ 7$, (*c*) The layer immediately below (*b*), 50 km from surface $P = 7\ 5$, $S = 4\ 5$ A Imamura F Kishinouye, and T Kodaira have begun the investigation of the effects of a surface layer of sedimentary rocks overlying the 'granite' layer, basing their work on records of 21 of the 65 moderate shocks that affected the Kwanto district during 1927 (*Bull Earthquake Research Inst*, Tokyo Dec 1929, p 485) Adopting the above data by Matuzawa they find the sedimentary layer to have a thickness of the order 10 km It is not clear, however, that the latter was not already tacitly included in Matuzawa's 'granitic' layer, and until this ambiguity is cleared up the Japanese results remain difficult to interpret

Spectrum of Sodium Hydride—We have received from Prof Takeo Hori, Port Arthur College of Engineering, South Manchuria, a letter describing a band spectrum of sodium hydride which he has obtained in absorption by passing the light from a lamp through sodium vapour heated to 750° C in hydrogen at atmospheric pressure The spectrum between 3680 A and 4450 A was examined in the second order of a

concave grating two metres in radius, and bears a superficial resemblance to the secondary spectrum of hydrogen In spite of its complexity it has, however, been almost completely analysed into seventeen bands, each of which consists of a P branch and an R branch degraded to the red The type of electronic transition involved is ${}^1\Sigma \rightarrow {}^1\Sigma$ An anomaly occurs in the energy of the upper ${}^1\Sigma$ state similar to that found by Nakamura with lithium hydride The moment of inertia of the molecule in the normal state is $5\ 6_4 \times 10^{-40}$ gm cm ^{2}, and the other molecular constants, with the usual notation, $\omega_e'' = 1133$, $B_e'' = 4\ 89_3$, $D_e'' = 3\ 3 \times 10^{-4}$, and $r_e'' = 1\ 9 \times 10^{-8}$ cm

The Nature of Positive Electricity —The first March number of the *Physical Review* contains a letter from J R Oppenheimer, criticising Dr Dirac's theory of positive electricity (see NATURE Feb 1, p 182) Two difficulties occur in connexion with the interaction between radiation and matter applied to this, the theory necessitates the presence of an infinite density of positive electricity, and also predicts that protons and electrons should be equally efficient in scattering soft radiation, whereas it is probable that scattering by protons is relatively unimportant A third difficulty is that, according to Mr Oppenheimer's calculations, the rate of destruction of protons by electrons is far too great The approximate formula for the mean free life (T) of an electron in an enclosure in which there are n free protons per unit volume is $T = m^2c^3e^{-4}n^{-1}$, where e and m are the charge and mass of an electron, and c the velocity of light, which gives a mean free life for ordinary matter of the order of 10^{-10} sec A way of avoiding these difficulties is suggested, but it involves the rejection of the fundamental similarity of positive and negative electricity, which was perhaps the most attractive feature of Dr Dirac's theory, and a return to the hypothesis of two types of independent elementary particles, dissimilar in mass and with opposite charges

Technical Sound Problems —An introductory address on this subject given by Dr E Lubcke of Berlin at the Brunswick Technical School in February, is reproduced in the issue of *Die Naturwissenschaften* for Mar 14 It deals mainly with the use of sound at sea, and in flight, and with the methods suitable for diminishing its propagation in buildings A receiver of the Riegger and Wente type has been used in air, but in water one of the carbon microphone or the condenser type is used The sounds sent out by several types of ship are analysed, and sound spectra are given of a motor boat with its engine making 420 and 600 revolutions per minute, of a tug boat and of a vessel driven by electric motors of high speed The records of an under water explosion are also reproduced, and the method of echoes as used in sounding at sea or from an airship explained In dwellings the oscillations due to traffic are of frequencies 10 25 per second and increase in amplitude from the ground floor upwards to about four times in the first storey and about sixteen times in the second storey that in the ground floor An amplitude of 0 03 mm is already disagreeable, and if due to resonance is reduced by stiffening the floor or wall which is affected In order to prevent sound from penetrating walls, it has been found necessary to use materials weighing at least 150 kgm per square metre of wall

Wireless Defects —In an address to the Institution of Professional Civil Servants, published in the March issue of *State Service*, entitled "What is wrong with Wireless", Mr R A Watson Watt put very clearly before his audience the difficulties which confront broadcast radiotelephony at the present time He considers that the loud speaker, in failing to reproduce in proper proportion the whole of the notes of the musical scale, is the principal offender, the last valve in the average receiver the next, followed by the microphone with its favourite frequencies and its tendency to produce 'blasting' noises during *forte* passages, then the difficulty of spacing out the wavelengths sufficiently when 1000 stations have to be accommodated between wave lengths 100 metres and 2000 metres Lastly, he blames the fading out of signals due to the interference between the direct waves, and those which arrive by reflection in a conducting layer of the atmosphere between 60 miles and 150 miles above the surface of the earth Mr Watt looks forward to the time when these defects will be remedied, but he sees in atmospherics the ultimate limitation on wireless signalling

Building Material and Heat Insulation —Two of the papers read to the International Heating and Ventilating Exhibition at Washington, which are abstracted in a recent *Daily Science News Bulletin* issued by Science Service, Washington, D C, illustrate the advantage of building houses with materials the thermal conductivity of which is low It was found by experiment that a breeze blowing at seven miles per hour and one degree colder than the surface of the building on which it is blowing will carry away by convection three British thermal units of heat from each square foot of surface per hour When the wind is blowing at thirty miles per hour, under the same condition it will carry away eight heat units per hour We may say, roughly, that the heat carried away by convection varies as the square root of the velocity of the wind This law is well known to electricians in connexion with the heating of overhead electric wires The experiments were carried out at the University of Minnesota Further experiments were made on the heating of surfaces by direct radiation from the sun It was found that on an ordinarily bright day in the smoky city of Pittsburg, a piece of black oil cloth ten feet square would receive energy from the sun at the rate of about 45 British thermal units per minute This is equivalent to the oil-cloth receiving energy from the sun at the rate of one horse power If the house is to be kept cool, this shows the necessity of using building materials which are good thermal insulators

Pyrophoric Iron —It has long been known that finely divided iron reacts with incandescence with atmospheric oxygen at room temperature, and several theories have been proposed for the phenomenon In the January number of the *Journal of the American Chemical Society*, T G Finzel describes the preparation of the material, chiefly with the view of investigating the effect of the initial substances used and of various gases on the pyrophoric properties of the iron The iron becomes inactive when heated for some time It was found that the best iron was obtained by the reduction of ferric oxide, precipitated from ferric nitrate, in hydrogen at 500° Chlorides are to be avoided, as they destroy the pyrophoric property of the iron Inactivation depends not only on the temperature and time of heating but also on the gaseous medium One sample became inactive after heating at 600° for 2 5 3 hours in hydrogen, but only after 156 hours in helium, Inactivation appears to be due to decrease in total surface Iron was pyrophoric in dry air and also in air cooled to −78° The adsorption of gases by the material was very irregular, adsorption of carbon dioxide was no criterion for pyrophoric activity Iron prepared from colloidal oxide obtained by hydrolysing ferric nitrate and dialysing was worthless as an ammonia catalyst

High Frequency Fatigue[1]

MESSRS G F Jenkin and G D Lehmann have prepared an important report on the subject of high frequency fatigue These researches, the object of which was to determine the effect of the frequency of alternation of stress on the fatigue limits of various metals, were carried out in the Engineering Laboratories of the University of Oxford, and tests were made on rolled, normalised, and hardened steel, rolled aluminium, annealed copper, and normalised armco iron The ordinary frequency employed in fatigue tests is 50 periods per second though in 1924 Jenkin[2] carried out work up to 2000 periods per second, and in the research described in this paper frequencies up to 20,000 periods per second were used In all the higher frequency tests the specimen consisted of a bar supported at the nodes, and vibrating freely

Jenkin had previously used an electromagnetic method to produce the vibrations, but this will not work for very high frequencies and a new method had to be designed On the experiments now described fluctuations of air pressure acting directly on the specimens were used to make them vibrate The apparatus was essentially two blowers, each blower consisting of a small adjustable resonating chamber, into which air was admitted by a throttle valve in the back, while the front was closed by one face of the specimen The position of the specimen was so arranged that as it vibrated to and fro it alternately released the air pressure or allowed it to mount up in the chamber

The strains were calculated on the assumption that the bar vibrated freely and the only measurement necessary was the amplitude of vibration at the centre of the bar Lord Rayleigh has shown how the strains may be calculated for a long, thin vibrating bar, but using the method of vibrating by air, the bars had to have a moderate width and, for the highest speeds, had to be short, with the result that Lord Rayleigh's theory was no longer sufficiently accurate Prof Love, however, has explained how the theory could be applied to bars of moderate width, such as were used in this apparatus

The results obtained are of very great interest In Jenkin's earlier experiments the largest increase of the fatigue limit observed was only 15 per cent, but, as he pointed out, much larger rises were to be expected at higher frequencies In the present tests, the fatigue limit in all cases increases as the frequency of vibration is raised and increases of fatigue limit up to 60 per cent have been recorded It has also been found that the fatigue limit does not increase indefinitely with the frequency, but apparently reaches a maximum value at a certain critical frequency In some tests it was actually shown to fall at the highest frequencies, the greatest drop obtained beyond the maximum fatigue limit being about 9 per cent of the maximum This fall would probably have occurred for the other metals also, if they had been tested at still higher frequencies The results obtained are summarised in the following table

Material	Critical Frequency (Approx)	Maximum Fatigue Limit (Tons/sq in)	Ratio Maximum F L to Ultimate Tensile Stress	Ratio F L at 50 ~ to Ultimate Tensile Stress	Maximum Increase above F L at 50 ~ (Per cent)
Normalised 0 11 per cent carbon steel	20 000	>17 99	>0 799	0 631	>26 7
Rolled 0 11 per cent carbon steel	>20 000	26 25	>0 588	0 528	>11 5
Annealed copper	10 000	5 50	0 385	0 324	18 8
Rolled aluminium	20 000	5 02	0 785	0 586	33 9
Normalised armco iron	10 000	18 1	0 903	0 685	31 6
Hardened 0 86 per cent carbon steel	10 000	32 4	0 658	0 400	62

[1] Air Ministry Aeronautical Research Committee Reports and Memoranda No 1222 (M 62) High Frequency Fatigue By G F Jenkin and G D Lehmann (F F 219) Pp 34 (London H M Stationery Office 1930) 1s 6d net

[2] *Proc Roy Soc*, A vol 109 1925

South African Vegetation

DURING the recent meeting of the British Association in South Africa, the South African Association for the Advancement of Science may be said to have acted as scientific hosts to their visitors, and in that capacity they certainly spared no effort to provide information as to South African scientific activities which would interest their visitors from the northern hemisphere As a result, the number of the *South African Journal of Science* issued in December 1929, which contains some of the papers read at the 1929 meeting, provides an exceptionally favourable means of gaining a comprehensive impression of South African science The president, Dr Jan H Hofmeyr, in an eloquent address pointed out that, since the first visit of the British Association in 1905, there has been a great increase in the facilities for higher education throughout South Africa, and the 27 graduates of 1905 had increased to 314 in 1928 There has naturally, therefore, been a great amount of valuable scientific work carried out throughout the country since 1905, and Dr Hofmeyr emphasises, as the outstanding feature of this period, that the bulk of this work is due to the activities of South Africans Scientific data are no longer the result of the sporadic activity of visitors from older communities with a longer academic history, they result from the continuous labours of a number of South African investigators, many of whom have received their training in South Africa

Biologically, South Africa is the product of its climate, its sunshine, its clear dry air, and its dependence upon rainfall The remarkable vegetation of this great continent is very much influenced by the very characteristic physical and climatic features of the country, and this report, describing pioneer work in many fields, naturally has to give great space to the tentative generalisations that emerge as to the natural vegetation of the country and as to economic possibilities in agriculture and forestry Prof J H Wellington points out, however, that the three characteristic South African regions, as determined by seasonal precipitation, are equally important in determining human activities These regions are

(1) The western part of Cape Province, with a winter rainfall associated with westerly and north westerly winds from the South Atlantic anticyclone The visiting botanists obtained a slight impression of the possibilities of this type of weather on the occasion of their excursion to the Kirstenbosch Botanic Garden

(2) The vast central and eastern area of the sub

continent, with a summer rainfall, carried to it by the east and north east winds from the anticyclone over the South Indian Ocean

(3) The intermediate region, mainly a coastal strip, on the south and east, where, as a result of its intermediate position, the rains are fairly evenly distributed throughout the year

The high tableland that fills the interior of the continent means that the rain laden winds usually lose their moisture at the mountain barriers near the coast As a result, over a great part of the interior of the continent the rainfall is very scanty, and the deficient moisture supply is the dominant factor determining both natural vegetation and possibilities of cultivation

In the south west of the Cape Province, with its adequate winter rainfall, cultivation is of the type associated with the Mediterranean seaboard Provided there is enough potash, vines may be grown on the alluvial soil, and many visitors will have grateful recollections of the local vintages and the local liqueur Van der Hum The olive, apparently, cannot compete with European conditions for economic rather than climatic reasons But if cultivation problems are somewhat the same, the natural vegetation of the Cape Province is entirely different, for reasons that Dr Marloth makes clear We have in the Cape flora a remarkably diversified vegetation which, in an area about one tenth of the country south of the Orange River, contains as many species as in the remaining nine tenths The bulk of these species are so remarkable in form and so new to the visitor that even the non botanist is led to wonder and admire Dr Marloth lists 64 genera, containing 615 Cape species, which between them include only 19 species that are found outside the Cape region These plants form part of the characteristic southern, sub Antarctic flora, with affinities rather with other Antarctic land masses, and which has remained isolated and distinct by reason of the 'physiological isolation' imposed upon it by the arid tableland that intervenes between it and more northern floras, so that such invasion as does occur takes place either along the more richly endowed coastal strip, or by sea Most of the familiar plants that the visitor first notices, the oaks, the weeds, etc , result from the long history of the Cape as a port of call upon the ocean route to India, before the making of the Suez Canal

Most of the northern immigrants are also unfamiliar to British visitors, being elements identical with, or related to, the main African flora, Acanths, Asclepiads, Euphorbias, etc , and most of the native forest trees , comparatively few familiar northern genera, *Anemone*, *Rubus*, *Hieracium*, etc , are to be seen As a result, the botanist from the northern hemisphere is at first swept off his feet by the vast assembly of striking forms of plants that are new to him , even in the Cape winter the Ericas and Proteas provide him with a wonderful array of flowers , in the spring, the numerous bulbous monocotyledons give sheets of colour on the hillside, and all the year round the flora is full of interest The extraordinarily pronounced development of ericoid vegetation forms at the Cape also strikes the visitor , 21 4 per cent of the flora of French Hoek have ericoid leaves, according to Dr E P Phillips , many of these plants being characteristic of an acid, if not a peaty, soil

Northwards of the Cape, on the high inland plateaux, over many miles of ground, stretches the Karroo, with a rainfall averaging between 3 and 12 inches annually This Karroo vegetation varies greatly in type on the east with a summer rainfall we have a scanty grass veld, merging westwards into the 'Composite' Karroo, grazed by Persian black faced sheep and goats , on the west, with a winter rainfall, the paradise of the succulents, where the more arborescent types predominate until the flora merges into the scrub areas of the coastal belt

Prof R H Compton has a brief note on this interesting vegetation He points out that it is recruited from north and south From the Cape come the leaf succulent Mesembryanths and Crassulas, from the north, stem succulent Euphorbias, Asclepiads, etc , and from the south, geophilous bulbous Monocotyledons, unpalatable Composites, the staple shrubs of the Composite Karroo, and from the igneous outcrops of the Transvaal and Rhodesia come curious plants with 'resurrectionist' habit, etc

Where rainfall is slightly more favourable, the bush savannah or the high veld stretches over many miles of the Transvaal and Rhodesia Dr E P Phillips describes this interesting vegetation in the environs of Pretoria, where high veld and bush veld meet He points out that the tropical element is conspicuous in the bush veld, which shows close affinities with the Kalahari flora

SOUTH AFRICAN FORESTRY

Dr H M Steven has written his impressions of the high forests of South Africa, gained during the British Association tour in 1929, in *Forestry*, vol 3, 1929 The natural high forest in the region of Knysna and George, where rainfall may be expected throughout the year, is a mixed, temperate rain forest type, which in the past has been exploited regardless of the future It is now under the care of a scientific forest service which studies its natural regeneration, but probably no skill could make this natural forest, with its superabundance of hardwood species, and relatively slow increment growth, an economic asset It remains a national asset, and is well worth the care it receives, but South Africa is concerned with the fact that it exports its fruit in boxes made of imported timber and is rapidly introducing exotic softwoods to meet the needs of the industries of the Union Messrs G A Zahn and E J Neethling give an account of progress to date along these lines *Pinus pinaster* has been planted most extensively in the past, but *P insignis* and *P canariensis* now stand higher in favour and are being planted very extensively The yield of wood is already sufficient to enable Mr M H Scott to give some preliminary notes upon the behaviour of the timber of such exotic conifers, whilst the high moisture contents recorded by Mr Nils B Eckbo (for example, 474 per cent on dry weight in the sapwood of *Cryptomeria japonica*) are a reminder that these studies deal as yet with very young grown timber

A new industry of considerable importance has sprung up around the cultivation of the introduced black wattle, *Acacia mollissima*, from which bark and tannin extract are exported annually to the value of about one million pounds Mr A J O'Connor and Dr I J Craib deal with its sylviculture, whilst it would appear, from Mr E F English's account, that most preliminary experiments on paper pulp production from South African hardwoods have been carried out upon the wood of the black wattle With the tree grown especially for bark, a use for the timber is obviously an urgent economic problem

It is interesting to note, with the distribution of the natural forest, and in the problem of plantation management, the dominant external factor in South African conditions is again the water supply Indeed, Dr I J Craib argues, on the basis of his experience gained at the Yale Forestry School, that the moisture content of the soil is in general of more importance than light in forest growth and in controlling the succession of events beneath the forest canopy, that go so far to determine the stability of forest conditions

Dr Craib's discussion of this problem has very general biological interest, as, indeed, do many of the contributions in this issue of *Forestry*, which seem primarily of economic interest

Another very interesting ecological problem is the way in which the diversified native flora is sometimes superseded, as the result of fire or over grazing, by almost pure stands of some particular plant Mrs Levyns gives a brief account of her extensive observations upon one such case, the extensive spread of the rhenoster bush, *Elytropappus rhinocerotis*, which has displaced pasture on the veld under such conditions She shows that the seedlings of this plant flourish when germinating in completely exposed sites where many competitors wither and die, and that germination of the seeds may be better after exposure to a fire—observations which may explain the spread of this plant, which is useless as pasture Sometimes the plants that oust the varied native flora are aliens, as several species of *Hakea* that cover the slopes of Table Mountain after fires

Grasslands

South Africa is now grazed much more closely by the stock of the settlers than was previously the case when wild game alone roamed in the veld For many miles, in the dry South African winter, the only fruiting grass haulms seen from the railway will lie inside the wire fence that protects the rail track from the stock Outside this fence, every palatable plant is grazed ruthlessly down to soil level, and only plants with conspicuous powers of regeneration are able to survive the onslaught The control of grazing so that future resources are not needlessly impoverished, is probably the line of surest advance in many agricultural problems, and the doyen of American agrostologists, Prof A S Hitchcock, of the Smithsonian Institution, has a brief paper upon the relation of grasses to man, which, whilst it emphasises the great importance of these plants is full of wise counsel as to the conservation of grazing land based upon the experience of the United States, where over grazing with the consequent depletion of the range has been a pressing problem, as indeed it has always been in the history of stock raising on open grassland since the days of Abraham

The paper by Messrs R R Staples and A J Taylor upon pasture management shows that South Africa is already attacking its own problems in this field They show that frequent clipping on the veld, to simulate close grazing, materially affects the normal grass flora, both the dominant species, *Themeda triandra* and the coarse pioneer grass, *Eragrostis alba*, succumbing very early under such treatment, whilst an introduced pasture grass, *Paspalum dilatatum*, survived the treatment much better One of the most important results so far obtained in grassland management is undoubtedly the dominant significance of phosphate deficiency in most South African soils Dr I de V Malherbe states that phosphate treatment of arable soils practically always gives a large increase in yield and Dr P J du Toit emphasises the fact that phosphate manuring of grasslands in the form of bone meal has revolutionised the cattle industry in certain parts of South Africa He suggests that, with a small daily ration of the missing mineral, it should be possible to raise improved breeds of cattle on the veld A number of other very interesting contributions, dealing with both the native fauna, the stock and the economically important pests of the cultivator, are also included in this Report of the 27th Annual Meeting of the South African Association", in this review it has been possible to mention only very cursorily some of the many contributions that deal mainly with South African vegetation under both natural and cultivated conditions

Weather and Climate of the Sahara

OUTSIDE the polar regions there is no extensive area of land the weather and climate of which has been so little studied as that of the Sahara, with the possible exception of Central Asia A certain romantic glamour seems to attach itself in the minds of most of us to that vast and little known desert region, and this gives additional interest to a memoir published by the Meteorological Office, Air Ministry (Geophysical Memoir No 48), which discusses in detail the meteorological observations made by Mr Francis Rennell Rodd in 1922 and 1927 in various parts of the Southern Sahara ranging from Timbuktu in the west nearly to Lake Chad in the east, and in latitude from about 12° N to 20° N

This is a region that owes its rainfall to a brief monsoonal incursion of south westerly winds from the southern Atlantic during the late summer These winds penetrate underneath the prevailing easterly or north easterly winds, probably to a height of about 1 kilometre, and the rainfall appears to be generally of a vigorous convectional type, the convection apparently mixes the opposing wind currents and often leaves the easterly wind in temporary occupation of even the lowest layers Occasionally this process gives rise to 'tornadoes' of the African type, which are of the nature of line squalls, not destructive vortices like American tornadoes, they give severe gales of short duration The rainy season appears to be a complicated affair, interrupted by various breaks There was an important autumnal part until about fifteen years ago according to the natives, and Mr Rodd experienced a cloudy spell in late November and early December that yielded a few drops of rain and lent colour to the local tradition He was not of the opinion that any important general desiccation of this part of Africa has been in progress either recently or during past ages

As in many other parts of Africa, the more mountainous districts tend to get abundant rain, while the relatively low lying plains not only have, on an average, a very small annual fall, amounting locally to less than five inches, but also one that is capricious, and in large areas a scanty desert vegetation is only precariously maintained

It is not in regard to rainfall, however, that the interior regions of the Sahara yield the most interesting weather, but in the matter of low relative humidity and the temperature contrasts that arise from it Unfortunately, the degree of dryness experienced when easterly or north easterly winds hold sway is too great for trustworthy treatment by normal hygrometry, and it would be necessary to make special direct absolute determinations to measure accurately the minute fraction of possible water vapour pressure contained by the air on those days when temperature rises to 114°, as happened in June 1922 and September 1927 Some idea was obtained by assuming that the vapour pressure remained constant between the cool early morning, when measurements by ordinary means could be relied on, and the time of greatest heat at 3 P M, so that the relative humidity was governed by air temperature alone There was reason for believing such an assumption to be nearly true, more than one calculation

indicated a relative humidity of only five per cent, with a probability that two per cent may be attained at times

The diurnal range of temperature is so great that, in spite of the very high day temperatures, frost is not unknown On Dec 14, 1922, the air temperature measured on a march by sling thermometer was 92° at 2 30 P M, and during the ensuing night in camp the minimum was 31°

University and Educational Intelligence

London —A Bayliss Starling Memorial Scholarship has been founded by old students, friends, and admirers in commemoration of the late Sir William Bayliss and Prof E H Starling The annual value of the scholarship is about £120, with exemption from tuition fees, and it is tenable at University College The Scholar will be required to follow a course of study approved by the Jodrell professor of physiology, involving a training in the principles of, and methods of research in, physiology and biochemistry Candidates must send their applications to the Secretary of University College not later than Wednesday, May 14

An election of junior Beit fellows for medical research will take place in July next The yearly value of each fellowship will be £400, and the tenure, ordinarily, three years Forms of application (returnable on or before June 1) may be obtained by letter only, addressed to Sir James K Fowler, Honorary Secretary, Beit Memorial Fellowships for Medical Research, 35 Clarges Street, W 1

Applications are invited from British subjects by the L C C for two Robert Blair fellowships in applied science and technology, each of the value of £450 and tenable for one year in the Dominions, the United States, or other places abroad Particulars and application forms (T3/300) are to be had on application to the Education Officer (T 3), The County Hall, S E 1 The latest date for the return of forms is June 18

University College, London, has just issued its report for the year ending February 1930, with statistics for 1928-29 showing a total enrolment of 3249 students, including 2399 whose homes were in the British Isles, 311 from the rest of the Empire, 52 from the United States of America and 487 from other parts of the world 1466 were in the different stages of degree courses, 523 were graduate and research students, 441 evening and 266 vacation students In addition, free public lectures, among them seven by visiting professors from the continent—Dutch (2), Belgian, German (2), Swedish, and Danish universities—were attended by more than 14,450 persons, the aggregate number of attendances at the 67 lectures being 29,590 Among academic developments during the year was the establishment of a chair of American history for which the Commonwealth Fund of New York gave 214,500 dollars The Centenary Fund, inaugurated three years ago to provide £500,000 for the completion of buildings and equipment and for endowment, amounted on Jan 31, 1930, to £223,860 The office of Provost of the College, held for twenty-five years by Sir Gregory Foster, on whom the honour of a baronetcy was conferred last New Year's Day, passed, as from the same date, to Mr Allen Mawer, formerly Baines professor of the English language in the University of Liverpool

Historic Natural Events.

April 20, 1897 Aurora Australis—A remarkable display of aurora was observed in the South Indian Ocean in lat 47½° S It began at 6 30 P M with a diffused light, horizontal flashes soon spread and flared in every direction, increasing in length and brilliancy, until at 7 30 P M they were shooting across the sky to within 30° of the northern horizon Cones and circles of light travelled rapidly over the whole sky, flashing beams of intense brilliancy from one to the other This continued until 8 30 P M, when an arch of bright green light fading off into yellow formed over the southern horizon, rose rapidly to a high altitude, and was followed by similar arches in regular sequence, until there were six distinct arches, their apices being from 10° above the southern horizon to 60° above the northern horizon They were formed of narrow vertical bands of light from 5° to 20° deep, bright green and yellow at their upper edges, and of a rosy hue at their bases At 9 P M a brilliant circle formed round the zenith, composed of narrow bands of light, pendant overhead and having a rotary motion, producing the effect of the vertex of an electrical cyclone The display lasted until 9 45 P M

April 22–25, 1547 Red Sun—In the whole of Germany, France, and England the sun appeared reddish and dull, like a ball with spots, so that the stars were visible (especially on April 24, during the battle of Muhlberg)

April 22, 1884 Colchester Earthquake—No British earthquake has resulted in so much damage to property as this shock Within an area of 10 sq miles to the south and east of Colchester, 1213 buildings and 31 churches had to be repaired In Colchester more than 400 buildings were injured, while at three villages—Abberton, Peldon, and Wivenhoe—about 70 per cent of the chimneys were thrown down The Colchester earthquake is one of the few British earthquakes that have been felt on the Continent, as at Boulogne and Ostend

April 24, 1579 Snow—Holinshed records that snow fell in London between 4 A M and 9 A M to the depth of a foot This is the more remarkable because, according to the present calendar, the date would have been early in May

April 25-26, 1908 Great Snowfall—This was one of the greatest spring snowfalls on record in the Midlands and southern England About six inches of snow fell near London on April 24, but the heaviest fall occurred on April 25, accompanied by a strong gale in the English Channel At Southampton, work at the docks was brought to a standstill, and throughout Oxfordshire, Berkshire, and the north of Hampshire all traffic by road was held up and communication by rail was maintained only with the greatest difficulty The thaw caused a severe flood in the Thames

April 25, 1926 Floods—Owing to a rapid thaw of the heavy snows of the preceding winter, the rivers of Russia were in flood, all the low lying parts of Leningrad, Moscow, and many other towns being under water The damage was accentuated by blocks of drifting ice

April 26–28, 1867 Gale and Floods in Brisbane—Rain commenced to fall on April 26 and continued throughout April 27, becoming torrential on April 28 On this day the wind rose to gale force, doing much damage The river rose rapidly to an abnormally high level, and the banks were covered by debris from the valley The lower parts of Brisbane were flooded

April 26, 1902 Green Flash—Mr C T Whittmell records in the Journal of the British Astronomical

Association that "In the belfry of the Wesleyan Chapel, on the west side of Woodhouse Moor, there are narrow, horizontal openings through which the setting sun can send his rays On Saturday, 26th April, between 7 15 and 7 30 P M I was so exceptionally fortunate as to observe, through the openings, no fewer than three green and red flashes The red ones were seen just as the base of the sun successively revealed itself below each of the upper edges of three openings The green ones were seen just as the top of the sun disappeared behind each of the lower edges of the openings Moving aside afterwards, in order to watch the actual sunset on the true horizon, distant some three miles, I observed a beautiful bluish green flash just as the sun's top sank out of sight at 7h 23m The sky was singularly clear, and there was a cool fresh breeze from north east "

April 26–29, 1928 Dust Fall —A great fall of dust took place in eastern Europe, travelling in a west north west direction from the coast near the Sea of Azov, as far as the upper Weichsel The darkness was so great that artificial light was in use all day, and in southern Russia the fallen dust formed heaps like snow drifts a foot or more in depth, but farther to the north west the depth was less than a sixth of an inch The origin of the dust is unknown, but it occurred with an easterly wind, and was heaviest where this wind reached the coast from the open sea

Societies and Academies

London

Linnean Society, Mar 20 —**C Tate Regan** A new Ceratioid fish (*Caulophryne* sp), female with male, from off Madeira The fish represents a new species of the genus *Caulophryne*, distinguished from *C jordani* Goode and Bean by the greater number of dorsal and anal rays and by the filaments on the stem of the illicium Although distended by a recently swallowed fish larger than itself, it took a bait, and was caught on a long line off Madeira The specimen is a female, 210 (145 + 65) mm long, with a dwarfed and parasitic male 21 (16 + 5) mm long attached to its abdomen —**Lieut -Colonel J Stephenson** On an Oligochæte worm parasitic in frogs of the genus *Phrynomerus* A specimen of a Nigerian frog, *Phrynomerus microps*, recently examined had a number of small worms hanging out in a cluster of about a dozen from the anterior angle of each eye and from under the neighbouring part of the lower lid The worms belonged to a new species of the genus *Nais* of the freshwater family Naididæ In a second species of the genus *Phrynomerus* (*bifasciatus*), from Beira, Portuguese East Africa, the Harderian (lacrymal) glands were found to be distended and transformed into a sac containing a number of small worms , these belonged to the same species as the preceding This discovery prompted the stripping of the mucous membrane from the roof of the mouth of the first frog, from Nigeria, when it was discovered that in it also the Harderian glands contained a number of the worms Oligochæta are rare as external, and still rarer as internal parasites

Society of Public Analysts, April 2 —**Ella M Collin** The separation of cadmium and copper in spelter and zinc ores by internal electrolysis The most satisfactory method is to deposit the copper first from a sulphate solution containing a small excess of sulphuric acid, to dissolve the copper in excess of nitric acid, and to electrolyse the solution at 70° The original sulphate solution is readjusted with ammonia, sulphuric acid, and sodium acetate, and the cadmium electrolytically deposited The anodes are of zinc, and a 5 per cent solution of zinc sulphate acidified with sulphuric acid is used in the anode compartments —**A F Lerrigo** Routine detection of nitrates in milk A modification of the diphenylamine test is capable of detecting the addition of 5 per cent of a water containing about 0 5 part of nitric nitrogen per 100,000 The test is regularly applied in Birmingham to all samples of milk containing less than 8 5 per cent of solids not fat —**J C Ghosh** The determination of titanium as phosphate The prepared ore or clay is fused with sodium carbonate, and the mass treated with boiling water, which dissolves aluminium and silica as sodium salts, leaving sodium titanate in the residue This is hydrolysed and is then dissolved in either sulphuric or hydrochloric acid and when boiled yields a precipitate of metatitanic acid This is dissolved the solution just neutralised with ammonia, and the titanium precipitated and weighed as phosphate

Leeds

Philosophical and Literary Society, Mar 4 —**J E Roberts** Note on the critical potentials of the hydrogen molecule The observed critical potentials of the hydrogen molecule are considered in the light of the potential energy curves for the various states and the Franck Condon principle The most probable energy change requires 12 8 volts, though this is not, strictly speaking a critical potential, the latter being in the region of 12 volts A further potential between 8 and 9 volts reported by Jones and Whiddington is probably due to the excitation of the triplet states with consequent dissociation of the molecule and emission of the continuous spectrum – **J E Roberts and R Whiddington** The passage of electrons through argon Excitation potentials of argon have been investigated experimentally by the magnetic spectrum method already described The three sharp loss lines have been examined photometrically, and found to be much narrower than the corresponding loss lines in the case of certain diatomic molecules In order of intensity, the losses in volts of the lines are 11 6, 14 1, 13 0, and this is the descending order of their intensities —**E C Stoner** (1) Free electrons and ferromagnetism The question is considered as to whether ferromagnetism may be due to 'free electrons', that is, electrons forming an 'electron gas' as in Sommerfield's theory of conductivity For spontaneous magnetisation to occur, the change in the interaction energy associated with magnetisation must exceed the increase in the kinetic energy of the electrons On this basis, it is shown that the Curie temperature θ would have a minimum value depending on the saturation intensity I_0 To a sufficient approximation $\theta > 6\ 74 \times 10^{5} \times I_0^{2/3}$ This gives $\theta > 43{,}160°$ for nickel (observed 640°) and correspondingly large values for other ferromagnetics It is concluded that ferromagnetism is not due to free electrons, but to interchange interaction electrons as in Hasenberg's theory If the 'magnetic' electrons are the same as the conduction electrons, as Dorfmann's thermo electric measurements indicate, it follows that conductivity may be due to interchange electrons The bearing of this on the theory of the magnetic and electric properties of metals is indicated (2) The interchange interaction theory of ferromagnetism Considering the atoms in a crystal as separate systems interacting with neighbouring atoms, a very simple treatment of the interchange interaction theory of ferromagnetism is given The method differs from that of Heisenberg, who considers the whole crystal as a single system The terms which make the original formulæ unsatisfactory

as a representation of the experimental results do not appear The final expressions of the magnetisation energy are formally equivalent to those given by the Weiss theory, if the classical assumption of continuous orientations of the carriers is appropriately modified The agreement with the observations on ferromagnetics is very satisfactory —**H Burton** Mobile anion tautomerism (Pt 5) γ phenyl α p-dimethyl amino phenylallyl alcohol Attempts to prepare the above alcohol have resulted in the formation of a mixture of products, which on treatment with hydrochloric acid furnishes a crimson coloration The cause of the colour is discussed —**E Cockerham** Some observations on cambial activity and seasonal changes in starch content of sycamore (*Acer Pseudoplatanus*) The activity of the cambium in producing both xylem and phloem has been followed throughout the year in all parts of the stem and root of *Acer Pseudoplatanus* Cambial activity is found to initiate in the buds in the spring, and from thence to work basipetally downwards on to the main roots In the distal region in the root this seasonal activity is thus superimposed upon a very slow cambial activity which seems to be practically continuous in this region of the root Fluctuations in starch content are discussed in relation to these data —**H L Newby** and **W H Pearsall** Observations on nitrogen metabolism in the leaves of *Vitis* and *Rheum* Ratio of protein to soluble nitrogen changes with the age of the leaf, and increases when the water content of the leaf is caused to fall The diurnal fluctuations in this ratio are correlated with changes in acidity, increases in acidity being associated with increases of the proportion of protein —**Rosa M Tupper-Carey** Observations on the anatomical changes in tissue bridges across rings through the phloem in trees In a zigzag bridge of phloem left across a ring upon a tree, the new xylem and phloem in the horizontal portion of the bridge is eventually formed with its elements extended in a horizontal direction The developmental changes in the cambium are followed in detail, which bring about this alteration in direction of the elements which differentiate from the cambium —**R G S Hudson** The age of the *Lithostrotion arachnoideum* fauna of the Craven Lowlands The recorded horizons of the various species of the *L arachnoideum* fauna are noted, and the faunal assemblage is considered to be of S_2 age The bearing of this determination on the age of the Clitheroe Pendle succession is discussed Various Lithostrotions are also re described

PARIS

Academy of Sciences, Mar 10 —The president announced the death of Camille Viguier, *Correspondant* for the Section of Anatomy and Zoology —**A Cotton** and **G Dupouy** Measurements of magnetic double refraction with the large Bellevue electromagnet Details of the methods employed for determining the field strength, and of the apparatus used in the optical measurements —**Lucien Daniel** was elected *Correspondant* for the Section of Botany —**Paul Lévy** The probability and the asymptotic frequency of the different values of the complete and incomplete quotients of a continued fraction —**Elie Cartan** The linear representations of the group of rotations of the sphere —**Georges Giraud** Certain problems at the limits concerning equations of the elliptic type —**Paul Flamant** The reduction and the independence of the conditions imposed on families of abstract vectors —**Georges Valiron** Integral functions defined by a class of Dirichlet series —**P Dupin** and **M Teissié-Solier** The distribution of the pressures round an immersed cylinder An experimental study of the distribution of the pressures on a cylinder immersed in a current of water, the results in non-turbulent flow being compared with those obtained with turbulent flow —**Alex Véronnet** The displacement of the poles and the deviation of the continents —**Corps** The interpretation of the Sagnac and Michelson experiments —**Henri Mineur** The field of gravitation of a variable mass —**F Joliot** The electrical properties and the structure of the metallic films obtained by thermal and cathodic projection A study of the causes of the resistance changes in these films the presence of occluded gas, slowing down the recrystallisation of the metal, would appear to be the principal cause of the diminution of electrical resistance —**H Pélabon** The copper oxide rectifier The results are given of a study by metallographic methods of a copper oxide–copper rectifier —**D Chalonge** and **Ny Tsi Zé** The variations of the continuous spectrum of the hydrogen molecule with the conditions of excitation —**G Déjardin** and **R Ricard** The first spark spectrum of mercury (Hg II) —**A Smits** and **Mlle C H Macgillavry** Remarks on the note of Mlle Maracineanu The authors have not verified the results of Mlle Maracineanu in all respects, but only so far as concerns the measurements relating to the radioactivity of lead from the roof of the Paris Observatory Details of a very sensitive method for detecting traces of mercury in lead are given —**H Deslandres** Remarks on the preceding communication —**Pierre Poulenc** The alkaline bromo salts of rhodium —**Marcel Godchot** and **Mlle G Cauquil** The methylcycloheptanols Details of the properties of three alcohols obtained by the reduction of the two methyl cycloheptanones described in an earlier communication —**R Cornubert** and **R Humeau** An ultimate property of the carbonyl group It has been shown that the ketone γ-methyl αα′ tetrapropylcyclohexanone gives neither an oxime, phenylhydrazone, nor tertiary alcohol with magnesium methyl iodide, and can only be characterised by reduction to the secondary alcohol and transformation into the acetate Another ketone, β methyl αα′ tetrapropylcyclohexanone, has now been found to possess similar abnormal properties, but this also can be converted by reduction into the secondary alcohol —**Léon Piaux** Some quaternary iodides derived from phenylaminoacetic acid and the corresponding betaines —**O Munerati** Observations on the duration of the cycle of the beet root —**H Bierry** Glycogen, glucidic reserves, in the starving animal —**Mlle G Cousin** The diapause of *Lucilia sericata* Experiments on *L sericata* have given results at variance with the views of Roubaud The diapause (arrest of larval evolution) can always be traced to external conditions —**H Colin** and **E Guéguen** The sugar of the Floridæ The sugar of the marine Floridæ is a compound of α galactose and has nothing in common with trehalose —**M Javillier** and **Mlle L Emerique** The vitamin activity of carotene Crude carotene, arising from leaves of spinach, has the physiological property of vitamin A It is active in very small doses, less than 0 01 mgm per day The activity of carotene remains high after keeping for forty years It still remains an open question whether the physiological effects of carotene are due to the substance itself or to some adsorbed substance —**A Leulier** and **L Revol** The distribution of cholesterol and its esters in the suprarenal capsules —**J Nicolas** Ulcerated X ray epithelioma cured by diathermocoagulation

PRAGUE

Czech (Bohemian) Academy of Sciences and Arts (Second Class, Natural Science and Medicine), Jan. 10 —**J. Milbauer**: Studies in the preparation of vege

table charcoal (1) The action of calcium chloride as activator The decolorising power of charcoal depends on the tissue of the initial material and the temperature and duration of burning The best material is that with a great content of celulose —**M Mikan** Cremona correspondence in quadridimensional space given by four correlations —**V Spaček** Complex swings of the magnetic declination needle —**E Votoček and F Valentin** Studies in the series of rhodeose (*d*-galacto methylose) —**E Votoček and V Kučerenko** Studies in the series of fucose (*l* galacto-methylose) In both the above communications the optical rotation of the derivatives of rhodeose, epirhodeose, fucose, epifucose are studied and an entire agreement is found with the Hudson's rule, this confirms Hudson's rule also in the series of methyl pentoses —**V Pospíšil** Experimental studies on the pressure effect of light upon microscopic particles —**O Michal** The *K* absorption and the satellites of the ferromagnetic elements The wave length of the *K* absorption edge is negligibly affected, when varying the crystalline diffraction grating —**J Klíma** The construction of flecnoidal lines on the skew planes of fourth order —**F Herles** The significance of the segment *RT* and of the wave *T* in the electrocardiogram for the diagnosis of pathological changes in the myocardium

WASHINGTON, D C

National Academy of Sciences (Proc, Vol 15, No 12, Dec 15, 1929) —**Chas W Metz and M Louise Schmuck** (1) Unisexual progenies and the sex chromosome mechanism in *Sciara* It has been shown previously that sex of individual depends on the sperm, but the types of sperm functioning depend on the zygotic constitution of the female Both characteristics are determined by the sex chromosomes, of which there appear to be three kinds —(2) Further studies on the chromosome mechanism responsible for unisexual progenies in unisexual progenies in *Sciara* Tests of 'exceptional' males Such individuals, to be expected on the hypothesis put forward above, were found —**M Demerec** Changes in the rate of mutability of the mutable miniature gene of *Drosophila virilis* The lines of mutable miniature are described and the rate of change from one to the other determined —**L J Stadler** Chromosome number and the mutation rate in *Avena* and *Triticum* Cultivated oats and wheat are polyploid forms and treatment with X rays produces very few mutants, as judged by seedling characters, in contrast with cultivated barley (normal chromosome content) in which many mutants are produced This appears to be connected with reduplication of chromosomes in polyploid species —**Donald A Johansen** A proposed phylogeny of the Onagraceæ based primarily on number of chromosomes —**Delmer C Cooper** The chromosomes of *Bugainvillæa* —**Robert F Weill** New results from the study of cœlenterate nematocysts (preliminary note) A comprehensive study of nematocysts from 109 species has been made, the nematocysts are of taxonomic value —**Harold Osterberg** An interferometer method of observing the vibrations of an oscillating quartz plate One mirror of the interferometer is replaced by the crystal, which is mounted so that reflection occurs at the surface to be examined —**Jenny F Rosenthal and F A Jenkins** Perturbations in band spectra (2) Perturbations in the Angström bands of carbon monoxide are discussed —**Marie J Weiss** On groups defined by $A^q = 1$, $B^{-1}AB = A^a$, $B^q = A^t$ —**Tracy Yerkes Thomas**: On the existence of integrals of Einstein's gravitational equations for free space and their extension to *n* variables.

Official Publications Received

BRITISH

Imperial Department of Agriculture for the West Indies Report on the Agricultural Department, Grenada for the Period 1926 to 1928 Pp ii+12 (Trinidad) 6*d*

Board of Education Educational Pamphlets, No 79 Report of an Inquiry into the Teaching of the Geography of the British Empire in certain types of Schools Pp. 29 (London H M Stationery Office) 4*d*. net

The Economic Proceedings of the Royal Dublin Society Vol 2, No 26 Experiments on the Establishment of Rice Grass (*Spartina Townsendii*) in the Estuary of the Lee By Prof H A Cummins Pp 419 421+plate 28 (Dublin Hodges, Figgis and Co London Williams and Norgate, Ltd) 6*d*

Report of the Marlborough College Natural History Society for the Year ending Christmas 1929 (No 78) Pp 120+5 plates (Marlborough) To Members, 3*s* non Members, 5*s*

Transactions of the Royal Society of Edinburgh Vol 56, Part 2 No 19 Chromosome Linkage and Syndesis in Œnothera By David G Catcheside Pp 467 484+3 plates (Edinburgh Robert Grant and Son London Williams and Norgate Ltd) 3*s* 6*d*

Government of India Department of Industries and Labour Note on the Functions Organisation and Present Developments of the Indian Meteorological Department Pp 12 (Delhi Government of India Press)

The Mining Institute of Scotland Fifty second Annual Report of the Council, 1929-1930 Pp 4 (Glasgow)

Asiatic Society of Bengal Presidential Address 1930 By U N Brahmachari Pp 12 Annual Report for 1929 Pp 30 (Calcutta)

Journal of the Chemical Society March Pp iv+321 569+xii (London)

Department of Agriculture Madras Bulletin No 89 The Conduct of Field Experiments By R O Iliffe and B Viswa Nath Pp vii+51 (Madras Government Press)

Transactions of the Geological Society of South Africa Vol 32, containing the Papers read during 1929 Pp iv+190+9 plates 42*s*. Proceedings of the Geological Society of South Africa containing the Minutes of Meetings and the Discussions on Papers read during 1929 to accompany Vol 32 of the Transactions January December 1929 Pp iii+ix (Johannesburg)

The Indian Forest Records Silviculture Series Vol 15 Part 1 Classification of Thinnings Pp vii+8 plates (Calcutta Government of India Central Publication Branch) 14 annas 1*s* 6*d*

Transactions of the Institute of Marine Engineers, Incorporated Session 1930 Vol 42 March Pp 10+208 (London)

Clifton College Scientific Society Report for the Years 1926-29 Pp. 24 (Bristol)

Souvenir Henry Hill Hickman Centenary Exhibition 1830-1930 at the Wellcome Historical Medical Museum 54 Wigmore Street London W 1 Pp 85 (London The Wellcome Foundation Ltd)

Indian Central Cotton Committee Technological Laboratory Technological Bulletin Series B No 5 A Comparison of some Methods of Testing the Breaking Strength of Single Cotton Fibres By Harirao Navkal and K R Sen Pp 10 (Bombay)

Ministry of Health Eighth Report of the Advisory Committee on the Welfare of the Blind to the Minister of Health 1928-29 Pp. 34 (London H M Stationery Office) 6*d* net

Ministry of Health Final Report of the Departmental Committee on Ethyl Petrol Pp 91 (London H M Stationery Office) 1*s* net

Proceedings of the Royal Society Series A, Vol 127 No A804 April 1 Pp 240 (London Harrison and Sons Ltd) 8*s*

Tanganyika Territory Department of Agriculture Annual Report 1928 29 Part 1 Agricultural Administration and Progress Pp 46 2*s* Part 2 Agricultural Investigation Pp 36 2*s* (Dar es Salaam Government Printer)

Scottish Marine Biological Association Annual Report 1928-29 Pp. 24 (Millport)

The Scientific Proceedings of the Royal Dublin Society Vol 19 (N S) No 34 Responses of Plant-Tissues to Electric Currents By Prof H H Dixon and T A Bennet-Clark Pp 415 420 6*d*. Vol. 19 (N S) No 35 Electrical Properties of Oil Water Emulsions with Special Reference to the Structure of the Plasmatic Membrane By Prof H H Dixon and T A Bennet Clark Pp 421 440 1*s* 6*d* Vol 19 (N S.), No 36 Studies in Peat. Part 4 Low Temperature Carbonisation under various Conditions. By Colm O Sullivan and Joseph Reilly Pp. 441 446 6*d* (Dublin Hodges, Figgis and Co, London Williams and Norgate, Ltd)

FOREIGN

Memoirs of the College of Science, Kyoto Imperial University Series A, Vol 13 No 1, January Pp 100 (Tokyo and Kyoto Maruzen Co, Ltd)

Proceedings of the United States National Museum Vol 77, Art. 8 A Revision of the North American Species of Ichneumon Flies of the Genus Odontomerus By R A Cushman (No 2826) Pp 15 (Washington D C Government Printing Office)

Annalen van de Sterrewacht te Leiden Deel 16, Stuk 4 Discussion of Old Eclipses of Jupiter's Satellites By W de Sitter Pp 80 (Leiden)

Publikationer og mindre Meddelelser fra Københavns Observatorium. Nr 67 Fortgesetzte Untersuchungen über asymptotische Bahnen im Problème Restreint Über das System periodischer, in Bezug auf die Achse unsymmetrischer, asymptotischer Bahnen Von Elis Strömgren Pp 61+2 Tafeln (København Bianco Lunos Bogtrykkeri A.-S.)

Occasional Papers of the Bingham Oceanographical Collection, Peabody Museum of Natural History, Yale University No 3 On the Osteology and Classification of the Pediculate Fishes of the Genera Aceratias, Rhynchoceratias, Haplophryne, Laevoceratias, Allector and Lipactis, with Taxonomic and Osteological Description of *Rhynchoceras longipinnis*, new species, and a special Discussion of the Rostral Structures of the Aceratiidae By Albert Eide Parr Pp. 23. (New Haven)

Report of the Aeronautical Research Institute, Tôkyô Imperial University No. 54 Application of the Inverse Wiedemann Effect to Torque Variation Recordings, Part 2 By Tatuo Kobayasi, assisted by Hiroto Okumura, Kinmatu Simamura and Tatuo Koyama Pp. 4+3 plates 0 22 yen No 55 On the Stability of Kármán Vortex Street in a Channel of Finite Breadth, II By Susumu Tomotika. Pp 5-48 0 47 yen No 56 Kuda no Tomonari ni tuite (On the Resonance of Pipes with a Movable End). By Kôzi Satô Pp. 49 92. 0 50 yen No 57 On the Possibility of Applying the Cathode Ray Oscillograph to the Indicator for High Speed Engines By Jûichi Obata and Yukio Munetomo Pp 96 100+2 plates 0 19 yen (Tôkyo Koseikai Publishing House)

Columbia University Bulletin of Information, Thirtieth Series, No 23 Professional Courses in Optometry, 1930-1931 Pp 30+3 plates (New York City)

United States Department of Agriculture Circular No 106 Tree Hoppers and their Control in the Orchards of the Pacific North West By M A Yothers Pp 15 5 cents Circular No 109 Parasitism of the Mediterranean Fruit Fly in Hawaii 1922-1924 By H F Willard and T L Bissell Pp 12 5 cents (Washington, D C Government Printing Office)

Proceedings of the United States National Museum Vol 76, Art 8 A new Variety of the Hexactinelid Sponge *Rhabdocalyptus dawsoni* (Lambe) and the Species of Rhabdocalyptus By H V Wilson and J T Penney (No 2805) Pp 9+2 plates Vol 76, Art. 21 Ordovician Trilobites of the Family Telephidae and concerned Stratigraphic Correlations By E O Ulrich (No 2818) Pp. 101+6 plates (Washington, D C Government Printing Office)

Collection des travaux chimiques de Tchécoslovaquie Redigée et publiée par E Votoček et J Heyrovský Année 2, No 3, Mars Pp 113 160 (Prague Regia Societas Scientiarum Bohemica.)

Rendiconti del Seminario Matematico e Fisico di Milano Vol 3 (1929 VII) Pp xv+267 (Milano)

Journal of the Faculty of Agriculture, Hokkaido Imperial University Sapporo, Japan Vol 28, Part 5 Pp 151 187 (Tokyo Maruzen Co , Ltd)

Scientific Papers of the Institute of Physical and Chemical Research Nos 221 227 221 Über die katalytische Reduktion des Kohlenoxyds unter gewöhnlichem Druck I Versuche über die Katalysatoren mittels Erhitzungskurve, 1, von Shinjiro Kodama 222 Über die katalytische Reduktion des Kohlenoxyds unter gewöhnlichem Druck 2 Versuche über die Einflüsse einiger Stoffe auf die katalytische Wirkung des Kobalts mittels Erhitzungskurve 2, von Shinjiro Kodama 223 Über die katalytische Reduktion des Kohlenoxyds unter gewöhnlichem Druck 3 Herstellung der flüssigen Kohlenwasserstoffe mit dem Kobalt Kupfer Thoriumoxydkatalysator, von Shinjiro Kodama 224 The Separation and Determination of Gallium 1 A new Method for the Determination of Gallium, by Sunao Ato, 225 On the Absorption Spectra of Salt Solutions. 1 The Absorption Spectra due to the Halogens and some Metallic Ions, by Sechi Kato 226 Resistance of Impact on Water Surface Part 1 Cone, by Shumpei Watanabe 227 Effect of Superposing Alternating Currents on the Electrolytic Oxidation of Aluminium (abridgement), by Shoji Setoh and Akira Miyata. Pp 193 274+plates 15 19 (Tokyo Iwanami Shoten) 1 25 yen

Contents and Index of Scientific Papers of the Institute of Physical and Chemical Research Vols 1 11 (1922-1929) Pp. 40 (Tokyo Iwanami Shoten) 66 sen

Ministerio da Agricultura, Industria e Commercio Directoria de Meteorologia. A Previsão das Séccas do Nordeste Ensaios pelo methodo de correlações Por J de Sampaio Ferraz Pp. 12 Memoria sobre o clima do Rio Grand do Sul Por Ladislau Coussirat de Araujo Pp iv+101 (Rio de Janeiro)

Abstract Bulletin of Lamp Development Laboratory Incandescent Lamp Department of General Electric Company Nela Park, Cleveland, Ohio Vol 2, No 1 January Pp ix+163+6 plates (Cleveland)

University of California Publications in American Archaeology and Ethnology Vol 28 No 2 Textile Periods in Ancient Peru By Lila M O Neale and A L Kroeber Pp 23 56+48 plates (Berkeley, Calif University of California Press London Cambridge University Press.) 60 cents.

Sudan Notes and Records Vol 12, 1929, Part 2 Pp 119-272 (Khartoum) 30 P T , 6s

Publications of the Earthquake Investigation Committee in Foreign Languages No 25 Topographical Changes accompanying Earthquakes or Volcanic Eruptions Pp ii+143+39 plates (Tokyo)

Bulletins of the Pacific Scientific Fishery Research Station Vol 3, Part 6 Паразитические черви рыб залива петра великого (Parasitic Worms from the Fishes of Peter the Great Bay). By E M Layman (With Summary in German) Pp 120 1r 60k Vol 4, Part 1 Морфометрическая характеристика западнокамчатской горбуши *Oncorhynchus gorbuscha* Walbaum (Morphometrical Characteristics of the West Kamchatka Humpback Salmon). By I F Pravdin (With Summary in English) Pp. 152 3r (Vladivostock)

U S Department of Commerce Bureau of Standards Circular of the Bureau of Standards, No. 380 Architectural Acoustics Pp 8. (Washington, D C Government Printing Office.) 5 cents

U S. Department of Agriculture Circular No 107 The Normal Breeding Season and Gestation Period of Martens By Frank G Ashbrook and Karl B Hanson Pp 7 5 cents. Technical Bulletin No 173 The Bluegrass Webworm By George G Ainslie. Pp 26 10 cents (Washington, D.C. Government Printing Office)

Proceedings of the American Academy of Arts and Sciences Vol 64, No 5 The Minimum of Resistance at High Pressure By P W Bridgman Pp. 75 90 45 cents Vol 64, No 6 The Reflecting Power of some Substances in the Extreme Ultra violet. By Paul R. Gleason Pp. 91 125 75 cents. (Boston Mass)

Publikationer fra det Danske Meteorologiske Institut. Communications magnétiques, etc No 8 La balance de Godhavn, par D la Cour, No. 9 Contribution à la théorie de l intensionmètre magnétique à l induction mutuelle de D la Cour, par Helge Petersen et D la Cour Pp. 28+4 (København G E C Gad.)

Proceedings of the United States National Museum Vol. 76, Art 17 Contribution to the Taxonomy of Asiatic Wasps of the Genus Tiphia (Scoliidae). By H W Allen and H A Jaynes (No 2814) Pp. 105+4 plates (Washington, D C Government Printing Office.)

The Kyoto Imperial University Publications of the Kwasan Observatory Vol 1, No 1 General Descriptions of the Kwasan Observatory of the Kyoto Imperial University By Prof Issei Yamamoto Pp. 16+4 plates Vol 1, No. 2 : Shih Shen s Catalogue of Stars the Oldest Star Catalogue in the Orient. By Joe Ueta Pp 17 48 (Kyoto.)

Smithsonian Institution United States National Museum Bulletin 104 The Foraminifera of the Atlantic Ocean Part 7 Nonionidae, Camerinidae, Peneroplidae and Alveolinellidae. By Joseph Augustine Cushman Pp vi+79+16 plates 65 cents Bulletin 149 Composition and Structure of Meteorites By George P Merrill Pp vi+62+32 plates. 40 cents (Washington D C Government Printing Office)

Scientific Survey of Porto Rico and the Virgin Islands Vol 10 Part 2 The Fishes of Porto Rico and the Virgin Islands—Branchiostomidae to Sciaenidae By J T Nichols Pp 159 295 2 dollars. Vol 10, Part 3 The Fishes of Porto Rico and the Virgin Islands—Pomacentridae to Ogcocephalidae By J T Nichols. Pp 297 399 2 dollars (New York New York Academy of Sciences)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol 82 A new Nightjar from Angola Second Preliminary Paper on the Birds collected during the Gray African Expedition 1929 By W Wedgwood Bowen Pp 2 Two new East African Birds Third Preliminary Paper on the Birds collected during the Gray African Expedition, 1929 By W Wedgwood Bowen Pp 3 7 (Philadelphia.)

U S Department of Commerce Bureau of Standards Research Paper No 137 Effect of Small Changes in Temperature on the Properties of Bodies By Mayo D Hersey Pp 137 156 (Washington, D C Government Printing Office) 5 cents

Annales de l Observatoire de Paris, Section de Meudon Publiées par H Deslandres Tome 7 Fascicule 1 Recherches sur la polarisation de la lumière des planètes et de quelques substances terrestres. Par B Lyot Pp ix+161 (Orléans , Impr Henri Tessier)

Travaux et mémoires du Bureau International des Poids et Mesures Tome 18 Pp vi+41+12+85+82+44+126+19+6 (Paris Gauthier Villars et Cie.)

Proceedings of the United States National Museum Vol 77, Art. 4 The Lysianassid Amphipod Crustaceans of Newfoundland, Nova Scotia and New Brunswick in the United States National Museum By Clarence R Shoemaker (No 2827) Pp 19 (Washington D C Government Printing Office)

CATALOGUES

The Nickel Bulletin Vol 6 No 6 March Pp 73 104 Publication R2 The Nickel Copper Alloys containing more than 50% Nickel. Revised edition Pp 24 Series B, No 6 The Practical Application of Nickel in Cast Iron Pp 12 Publication R1 The Nickel Copper Alloys containing less than 50% Nickel Pp. 28 Publication S1 Case Hardening and the use of Nickel Steels Pp 16 (London The Mond Nickel Co , Ltd)

Medicinal Glucose (Pura Dextrose) B D H Pp. 13 (London The British Drug Houses, Ltd)

Caprokol (Hexyl Resorcinol B D H), the Urinary Antiseptic for Oral Administration Pp 15

Diary of Societies

THURSDAY APRIL 24

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5 —H A Hayden Asymptotic Lines in a V_m in a V_n —V Naylor The Methods of Summation —G N Watson Theorems stated by Ramanujan (XII).

FRIDAY, APRIL 25

FARADAY SOCIETY (at Chemical Society) at 2 15 — Annual General Meeting

ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5 —Cinematographic Demonstration by Dr L G Rowntree Ganglionectomy in Chronic Arthritis —Prof Dixon and Dr G N Myers The Curative Action of Digitalis in Toxæmia

INSTITUTION OF MECHANICAL ENGINEERS, at 6 — F Carnegie The Economical Production and Distribution of Steam in Large Factories

ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8 —Prof S I Cummins Some of the Clinical and Pathological Factors underlying Mortality Rates in Tuberculosis.

INSTITUTION OF ELECTRICAL ENGINEERS (West Wales (Swansea) Sub Centre) —S W Melsom, A N Arman, and W Bibby Surge Investigations on Overhead Line and Cable Systems

SATURDAY, APRIL 26

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS

PUBLIC LECTURES.

THURSDAY, APRIL 24

INSTITUTE OF PATHOLOGY AND RESEARCH ST MARY S HOSPITAL, PADDINGTON, at 5.—Sir Almroth E Wright Twelve Years Work on Immunisation of the Blood *in vitro*

THURSDAY MAY 1

INSTITUTE OF PATHOLOGY AND RESEARCH, ST MARY S HOSPITAL, PADDINGTON, at 5 —Prof J Mellanby Absorption from the Alimentary Canal

CONGRESS.

APRIL 25 TO 28.

FLEMISH CONGRESS OF NATURAL SCIENCES AND MEDICINE (at Antwerp).

SATURDAY, APRIL 26, 1930

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Editorial and Publishing Offices
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Editorial communications should be addressed to the Editor
Advertisements and business letters to the Publishers.

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The Medical Profession in India

A NUMBER of pamphlets have recently been received at the offices of NATURE, in which are put forth the views of the Indian Medical Association and of certain of its officers on some questions of current medical interest in India The Association holds an annual meeting, the 'All-India Medical Conference', the sixth of these took place in Lahore on Dec 27–28, 1929 Three of the pamphlets relate to this meeting, and contain respectively the addresses of the president and chairman of the Reception Committee, and the resolutions passed at the conference No scientific or medical papers were read, the objects of the conference being rather political or medico political

The president's speech opened with a short discussion of the limits of the membership of the Association, it appears that the rule is to admit practitioners "who have such medical qualifications as may be from time to time recognised by the Association suitable for such membership", and the question is, whether this should include not only persons who follow the western system of medicine, but also those who have in different parts of the country practised any other system with repute and success, the president himself would desire to see included "members who honestly believe in his own system and practises it with a sincerity of purpose" (*sic*) The main part of the address, however, appears to be essentially (whatever topics may nominally be under discussion) an attack on the Government, and more especially on the Indian Medical Service, and its tenor may be illustrated by such phrases as the following

"Studied carelessness on the part of I M S officers in discharging the responsible duties cast upon them, namely, that of developing an Indian Medical Profession, the pre arranged method of keeping the Indian out of every opening where they could develop themselves, have been responsible for the present state of affairs", " those teachers who have developed only one form of speciality, namely, the speciality of possessing an overweening self-confidence, the speciality of rejecting all claims of the Indian practitioners to fair treatment, the speciality in belittling everything Indian", " this backdoor way of securing a few more lucrative posts for the members of the Indian Medical Service", (after referring to the heavy Indian mortality) " can nothing be done to prevent this enormous loss of man power in India? It is not necessary for me to mention that the history of the Government during the past 100 years has been such that we need not look for help or inspiration from the authorities'"

The resolutions passed at the conference are thirty-five in number, some deal with the Indian Medical Service, some with questions of registration, others take up questions of curriculum, or more general matters The fourth of the pamphlets, entitled "Some Problems of the Medical Profession in India", compiled by one of the joint honorary secretaries of the Association, brings together an address by Sir Nilratan Sircar to the conference of 1928, and correspondence and other documents relative to the four subjects of the co ordination of medical research in India, the reorganisation of the medical services, the Medical Council Bill, and the Bengal Council of Medical Registration We may briefly consider a few of the topics raised in the conference, while leaving others aside as of too limited general interest

The recognition of practitioners of the indigenous systems of medicine is advocated both by the president of the conference and by Sir Nilratan Sircar, who thinks that there should be chairs of Hindu medicine and of the Yunani system in the colleges, he would have us 'put ourselves *en rapport* with the genuine living representatives of the ancient medical art" in order to incorporate whatever of value there may be in the indigenous practice

It is perhaps natural at the present time, when national feeling is so strong among the educated classes, that Indians should express a belief in and seek to exploit these indigenous systems It is, of course, true that science is one, there can be no opposed eastern and western science, all students and practitioners belong to one body,—one body, that is, in so far as, and only in so far as, all recognise the same ideals and proceed on the same basic principle Annually at the Royal College of Physicians the Harveian orator of the year calls on his brethren, as he is bound by the terms of his office to do, to search out the secrets of Nature by way of experiment, and if a body of practitioners does this, or at least acquires a knowledge of, and accepts and bases its practice on, the results of the experimental method, won hardly and with difficulty through the ages, they are of the brothers of the true lineage and acceptable as such by the descendants of Hippocrates But to trust to ancient authority to the exclusion or neglect of more modern methods of research and their results, or to base the whole of practice, not on the body of scientific knowledge but on some single arbitrarily selected principle, such, for example, as that of homœopathy—this is to remain outside the brotherhood of science and the fellowship of those who carry on the torch of learning

The second principal feature of the speeches at the recent conference, the abuse of the Indian Medical Service and of Government, may be passed over briefly The conference was held in Lahore simultaneously with the National Congress, the beginning of so much native unrest, presumably the coincidence was designed, in order that the members of the conference might also attend the Congress, and that the conference might catch its fire and take its tone from the larger assembly Yet the conference can scarcely represent the attitude of more than a portion of the Indian medical practitioners—or at least one hopes not Certainly a very different picture is suggested by the contents of the *Transactions of the Seventh Congress of the Far Eastern Association of Tropical Medicine*, held in British India, and mainly at Calcutta, just over two years ago (see NATURE, June 22, 1929, and Mar 1, 1930) Though this congress was far from exclusively British Indian, the British and Indian members of the medical services and British and Indian practitioners naturally formed the bulk of the membership and contributed the majority of the papers, which contained a very large amount of work, much of it of a high order of merit, and if one may trust to the impressions gained by perusing the records of the meeting, one would say that the two races are working side by side in amity, with many personal friendships, and both producing much useful work

All that is of practical value in these publications seems to be contained in the pamphlet on "Some Problems of the Medical Profession in India" But here too the same spirit is apparent, thus one of the contributions states that "the Government, beyond reminding us that we are illiterate, has done practically nothing to educate us", which reads strangely to anyone who knows the enormous advances that have been made in recent years in education—elementary, secondary, and higher—by Government directly or with Government aid Again, "in measures for improving the health and social conditions of our people" Government "should not add their weight to the millstone that is already round the neck of our society", to those who know the magnitude of the Government's endeavours for such improvement, and how they are often in advance of general opinion in India, the suggestion contained in the last sentence is so false as to be merely grotesque

For the rest, there is much criticism of the

decision of Government to establish, in accordance with the findings of the Fletcher Commission, an Imperial Medical Research Institution at Dehra Dun, where the buildings of the recently displaced Forest Department would be available It is pointed out that Kasauli (where the present Central Research Institute is situated) is too isolated intellectually, though it has a good climate for research, being in the Simla Hills at a height of 6000 feet, Calcutta, or Bombay, on the other hand, though doubtless the climate is not so suitable or agreeable, have the advantage of being large centres of population, with universities, hospitals, and laboratories where research is going on in other branches of science, where team work would be possible, and clinical material available, but Dehra Dun has the advantages of neither, with the disadvantages of both It is quite possible that the contention is sound, it was announced in the House of Commons a short time ago that the question of the locality of the new Institute is to be reconsidered by the Government of India

The remaining questions—such as those of the relations of the military and civil branches of the I M S, the reservation of posts for the I M S, the All India Medical Council Bill, and the Bengal Council of Medical Registration—are too strictly medico political, and too complicated and thorny, to interest the majority of the readers of NATURE It may briefly be added that a new situation has recently arisen through the decision of the General Medical Council to withdraw its recognition of the medical degrees of Indian universities as qualifying for registration in Great Britain The controversy began in the limited opportunities (owing to Indian customs such as that of purdah) for obstetric instruction in India, and has lasted more than ten years, for some time past the recognition given to these degrees has been conditional, and been renewed for short periods, it now lapses entirely The matter can scarcely remain where it is, but it is not yet apparent what are to be the next steps taken in India

Botanical Exploration of Krakatao

The Problem of Krakatao as seen by a Botanist By C A Backer Pp iv + 209 (Weltevreden Visser and Co, The Hague Martinus Nijhoff, n d) n p

"VOLCANIC action", according to Sir Archibald Geike's "Textbook of Geology", "embraces all the phenomena connected with the expulsion of heated materials from the interior of the earth to the surface" The materials may, no doubt, have been pent up for some time in a simmering condition before the actual eruption, and in the case of a real volcano it is scarcely possible to predict when the eruption may occur

The book recently published by Mr C A Backer may be likened to what has been quoted above, but in this case the occurrence was timed to coincide with the opening of the Pan Pacific Science Congress held in Java last year Mr Backer has much to say that is of great interest and value in connexion with the Krakatao problem It is, however, unfortunate that he has written his account with so much acrimony, not unrelated, it would appear, to the fact that he was 'Formerly", as he states on the title page, "Government Botanist for the Flora of Java" His book deserves careful study, coming as it does from so critical a botanist, whose knowledge of the flora of Java exceeds that of any other worker in this field It is therefore much to be regretted that it is marred by the aspersions which he has cast on distinguished botanists, both dead and living, whose contributions to the Krakatao eruption history have come to be regarded as classics Why Mr Backer severed his connexion with the Buitenzorg Herbarium, where he was botanist for so many years, we do not know, but it is to be regretted that he has chosen the medium of a scientific work as a vent for the eruption in print of his own pent-up feelings

Mr Backer's book has been published forty six years after the eruption of 1883, and unfortunately none of the botanists and others who visited the Island in the earlier years are now living Though it will be agreed that much more might, and should, have been done in the way of detailed and prolonged investigation in the years immediately following the eruption, it is unnecessary to cast reflections on the investigations which Treub, Penzig, Raciborski, Boerlage, Clautriau, Valeton, Golenkin, Ernst, and others carried out at various times, since it is due to them alone that we possess such knowledge as we have of the state of affairs on the Island between the years 1886 and 1906

The main contentions with regard to the problem of Krakatao put forward by Mr Backer are that all vegetable life was not destroyed by the eruption of 1883, and that, except for the littoral flora, we know "nothing at all" about the manner in which the new vegetation has appeared Treub was the first botanist to visit the Island—in 1886, three years after the eruption. His visit was a brief one, and it is undoubtedly most unfortunate that an earlier

and detailed visit was not made, and that the mountain itself was not then, or during any subsequent visits, fully explored by a botanist There is good reason to assume that the ash covering on the steep south-east mountain slopes was not very thick On the lower slopes and on the shore, however, the ash covering was deep, and no doubt it was of so high a temperature that all the plants on and near the shore were destroyed Tropical rains must certainly soon have removed the lighter ash deposits on the higher mountain slopes, and if, as Mr Backer brings good evidence to show, the fine ashes which fell back on the summit were quite cooled down in falling from a great height, it is conceivable that plants with rhizomes and underground parts were able to recover and afterwards to refurnish the higher parts of the Island, while seeds and fruits may also have survived Treub, of course, stated, from his examination of the lower parts of the north west side of the Island near Zwarte Hock, that every living thing had been destroyed, yet in 1888 he records that he could distinguish plants growing near the top of the cone (some 800 metres in height), from the vessel on which he was sailing

It certainly is an unsolved problem, if Treub's observation was correct, how such plants could have originated, since transport of seed by wind from Java across so wide a stretch of sea seems scarcely possible Mr Backer himself had the opportunity of visiting Krakatao in April 1906, with Ernst, Pulle, and D H Campbell, but as he had not properly equipped himself for the expedition, he failed to climb higher than some 400 metres up the mountain Had he reached the upper slopes, the botanical information he could have given would have been of the utmost value As, however, he did not himself fully explore the mountain or make the detailed investigation which, as he rightly points out, was so much needed, his criticisms of others, and more especially of Dr Docters van Leeuwen, the present director of the Buitenzorg Gardens, seem singularly out of place

It is easy in these days, so long after the eruption, to point out the shortcomings of those who paid the early visits to the Island, but it must be remembered that the climbing of the deeply and intricately fissured mountain side, covered with ash and pumice, was fraught with difficulties well-nigh defying the attempt The ravines had almost vertical sides, and the ascent of the slope entailed a series of constant descents and ascents in and out of the deep fissures and ravines which cut the mountain side in all directions

Treub, it will be remembered, found eleven ferns growing on the rocks at Zwarte Hock in 1886 These are all species which grow on steep cliff walls, and it is conceivable, owing to the nature of their habitat, that they may have survived the eruption either by means of rhizomes or spores lodged in clefts of these basaltic cliffs, since neither pumice nor ashes could have lain there to any depth, and would quickly have been washed away by the rain In fact, two months after the eruption, Verbeek found the old rocks of Zwarte Hock locally bare, so that in well-sheltered localities part of the old fern vegetation may have survived as Mr Backer suggests

Mr Backer has a good deal to say about the incorrect determinations of the plants collected on the various visits As a systematist he is doubtless correct, but one cannot help objecting to the manner in which he expresses his criticisms With regard to the re covering of the Island, it is evident that the littoral vegetation is entirely new, and is due to seeds and fruits which have been washed up on the shores Mr Backer brings forward many arguments to show that very few, if any, seeds could have been wind-borne as has been assumed, though he considers seeds may have been brought over by birds and almost certainly by the many visitors and fishermen who have visited the Island His main contention, however, is that the old vegetation was not entirely destroyed, as stated by Treub, but that on the steep cliffs of Zwarte Hock, and on the south and south east higher slopes, living plants persisted From these remnants of the old vegetation he believes the slopes may have been reclothed downwards, and the fern population of the cliffs restored The new vegetation was certainly not long in making its appearance, since a year after the eruption an observer, on a ship, thought he saw some plants growing near the summit of the mountain

The mode of origin of the new vegetation of Krakatao, except for the littoral plants, must therefore be regarded as unsolved, since we know so little of what was actually growing on the Island in the first few years after the eruption, and it was not until twenty-three years had elapsed that any attention was paid to the vegetation on the eastern and south-eastern sides

Mr Backer's conclusions at the end of his book are typical of the spirit in which it is written He writes

"I have tried to find the very few bones in these wagon-loads of rubbish and will finish by stating once more, that

1 It is not at all proven that by the eruption of 1883 all vegetable life on Krakatao was destroyed

2 Even if this could be proven, we know—with the exception of the littoral flora—nothing at all about the manner in which the new vegetation has appeared Only guesses without scientific value have been made, but no reliable observations nor experiments

3 Therefore the Krakatao problem can neither now nor in the future either be posed [? proved] or solved, and is of no importance at all for Botanical Science "

A W H

Ovarian Secretions

The Internal Secretions of the Ovary By Dr A S Parkes (Monographs on Physiology) Pp xv + 242 (London, New York and Toronto Longmans, Green and Co, Ltd, 1929) 21s net

DR PARKES is one of the best known authorities on this branch of physiology concerned with internal secretions, and his book gives a comprehensive survey of all the past and current work carried out on the subject by the leading men of science of all countries During the last ten years or so a much keener interest has been taken in the properties of the ovarian secretions, as it has been gradually realised what an important part they play, and thus the amount of experimental data has been rapidly accumulating This has greatly added to the difficulty of Dr Parkes's task, as he has had to exercise great discretion in the choice of his subject matter, and it is never easy to distinguish between the important and relatively unimportant work of contemporaries, and to realise which views will stand the test of time and which will in later years prove to be erroneous It can, however, be seen at once that no space has been wasted in dealing with vague hypothetical considerations and views which are not supported by solid evidence, but only those are included which have been proved experimentally The book is very well and fully illustrated throughout, thereby greatly adding to the value and clarity of the text It is easy to see that the experiments on animals to show the functions and properties of the ovarian secretions are the careful work of experts, as they are all of them conclusive and have been carried out with the greatest accuracy

The book is divided into sections, the less detailed ones dealing with such subjects as the morphology of the female reproductive organs coming first There is no need for more than a very general account of this, as numerous anatomical and histological text-books contain fuller descriptions The author then passes on to a review of sexual periodicity in the female mammal, showing how certain animals have salient points in common There is a very interesting account of types of œstrus cycle in those animals in which it has been sufficiently studied, and this is followed by a section on the ovary as an organ of internal secretion

The œstrus producing hormone is dealt with by Dr Parkes in detail, no full account of this has previously appeared in the literature up to date, and the description of its preparation, properties, and administration is excellently done and will be found of great interest by all readers In the section dealing with the ovary and the anterior pituitary body, the author shows that it is only of recent years that the importance of the relation between these two has been discovered, and he discusses the many problems connected with this relationship

A detailed account of the chemistry of œstrin is given, stating the various methods of preparation with references so that those interested can obtain a full description From the general point of view, the most important section is the one dealing with the physiological effects resulting from its administration to animals The source of the material is also discussed and the significance of its occurrence in the bodily secretions of animals and men

In conclusion, we feel that this work will become a classic, and trust that new editions will appear at frequent intervals

Robert Hooke

Early Science in Oxford By Dr R T Gunther Vol 6 *The Life and Work of Robert Hooke* (Part 1) Pp xxiv + 396 31s 6d Vol 7 *The Life and Work of Robert Hooke* (Part 2) Pp viii + 397 806 31s 6d (Oxford The Author, Magdalen College, 1930)

THE two latest volumes of Dr Gunther's series of books on early science in Oxford deal with the life and work of Robert Hooke Dr Gunther makes high claims for the hero of his story, and if we cannot accept quite all his claims, we can at least agree that Hooke was one of the most prominent of those remarkable Englishmen who made the second half of the seventeenth century illustrious in the history of science

The volumes before us contain as preliminary

matter an essay by Dr Gunther in the form of a preface, and a reprint of Richard Waller's "Life of Hooke", first printed in 1705, with added extracts from John Ward's 'Lives of the Gresham Professors" (1740), and Aubrey's "Short Lives" The bulk of the work consists of notes on Hooke's experiments, discoveries, and inventions, extracted from the records of the Royal Society and other sources

Hooke was born in 1635 at Freshwater, in the Isle of Wight Though a weakly child, he was "very sprightly and active", amusing himself by "making little mechanical Toys" From Westminster School he went as a chorister or servitor to Christ Church, Oxford Here his early mathematical and mechanical aptitudes brought him into touch with Oxford men of science, and he became chemical assistant first to Thomas Willis, and then to Robert Boyle, whose "Pneumatick Engine", that is, air pump, owed much to Hooke's skill In 1656 or 1657, Hooke invented the anchor escapement for pendulum clocks, and, seeing the practical importance of accurate chronometry for the determination of longitude at sea, was led "to the use of Springs instead of Gravity for the making a Body vibrate in any Posture", and thus to the spring controlled balance wheel of watches and chronometers His attempt to obtain a grant of a satisfactory patent for this having failed, he put aside the application of the invention to chronometers, which first became practicable when in 1761 John Harrison corrected the balance wheel for thermal expansion

In 1662, Hooke was appointed curator of experiments to the newly founded Royal Society, and left Oxford for London, residing at Gresham College in Bishopsgate for the rest of his life As Miss A M Clerke says in her admirable account of Hooke in the "Dictionary of National Biography"

"The Registers of the Royal Society testify to the eagerness with which Hooke hurried from one inquiry to another with brilliant but inconclusive results"

Dr Gunther acknowledges this characteristic in other terms

"On the other hand, the fact that he had noted an idea in one of his synoptic tables probably led to his claiming it as his exclusive copyright This may explain why it not infrequently happened that when some new discovery was mentioned to him, he was apt to think that he had himself made it long before, whereas he had merely considered the possibility of such a discovery, and had noted it in an appropriate place in an 'algebra' With the onrush of other and newer interests, he had not been allowed time for following out the investigation suggested"

Nevertheless, Hooke's work comprises a long list of solid achievements Perhaps he is best known by Hooke's Law of Elasticity, *Ut tensio sic vis*, but that is merely one among many other discoveries and inventions Besides his mechanical ingenuity, shown in his improvements in watches and clocks mentioned above, and in the invention or improvement of numerous other scientific and technical instruments, he was a busy and successful architect, building Montague House, the Bethlehem Hospital, and the College of Physicians, and acting as surveyor to the City of London Moreover, he made notable advances in biology and chemistry he was one of the earliest microscopists, and described the cellular nature of living tissue, he proved that life could be maintained by blowing air over the surface of the lungs without muscular movement, and partly anticipated Mayow in a true explanation of combustion

Dr Gunther claims that 'it is certainly hardly fair to Hooke's memory that the coloured diffraction bands discovered by him should be everywhere known as Newton's rings" But the mere observation of the colours of thin plates—even the blowing of glass thin enough to show them—seems less meritorious than Newton's detailed study, with careful measurements and a calculation of the intervals of 'fits of easy transmission"—the first determination of the wave length of light Hooke's credit is that of the pioneer, who makes discoveries and suggestions and passes on The demonstration of the colours of thin plates, the idea that light was a wave motion, and a wave motion transverse to the direction of propagation, the attempt to measure the parallax of a fixed star, the proposals for flying machines, all are examples of Hooke's insight into possibilities for the achievement of which the time was not ripe

Probably Hooke's greatest work for science was done as 'curator' and later as secretary of the infant Royal Society He demonstrated not only his own experiments but also those of others whom he often helped in their difficulties If he sometimes showed a querulous temper, he had valid excuses, as Dr Gunther points out But, in the main, he set the fashion of that quiet and self-effacing helpfulness for which so many officers of the Society have been remarkable from Hooke's day to this How much Hooke did to further science at a critical stage in its history is well seen in Dr Gunther's two useful volumes

W C D D W

Our Bookshelf

Fungi and Fungous Diseases (Adolph Gehrmann Lectures of the University of Illinois College of Medicine, 1926) By Prof Aldo Castellani Pp iv + 203 + 4 plates (Chicago, Ill American Medical Association, 1928)

SIR ALDO CASTELLANI'S latest contribution to medical mycology is based on a course of lectures delivered by him in 1926 as Adolph Gehrmann Lecturer of the University of Illinois College of Medicine It is well recognised that the advent of the bacteriological era retarded considerably the development of mycology in its relationship to disease of man and animals, and even now, in spite of our vastly increased knowledge of pathological conditions associated with fungi, the systematic classification and nomenclature of these fungi have been the concern of but few professional mycologists Castellani has worked largely in this field and he has been able to combine with considerable success his well known clinical interest and experience of tropical skin diseases of fungous origin with studies of the fungi concerned

The inexpert reader will, we are afraid, be rather repelled than otherwise by the elaborate classification tables and well meant simplifications of them presented by the author He will note recent tendencies to replace old familiar genera by new and unfamiliar ones He will be grateful, however, for the author's account of the fermentative activities of fungi and the use to which these activities may be put not only as an aid to their systematic classification but even to the detection of particular carbohydrates in pathological fluids The author has given much attention to this subject, and, in particular, his employment of differential fermentation effects by known fungi in order to detect the presence of the rarer carbohydrates in fluids has aroused wide interest

The second half of the book deals with pathological conditions in man that are due to fungi and includes a description of interesting tropical skin diseases, to some of which Castellani was the first to direct the attention of dermatologists It contains some excellent photographs and coloured plates of skin lesions It is clear that a wide field is open for the co ordinated research of clinical pathologist and professional mycologist J C G L

Standard Methods for Testing Tar and its Products Pp xxix + 295 + 10 graphs (London Standardization of Tar Products Tests Committee, 1929) 7*s* 6*d* net

To ensure uniformity of analytical results on such composite products as many of those which fall within the generic term of ' tar products ', standard processes are, in most instances, essential The present volume is the outcome of a vast amount of work, carried out by a committee formed as the result of the advocacy in 1926 of the need for such standardisation In addition to members of the trade, the committee included—or rather includes, for it is still in being—external bodies who represent in some measure chemists approaching such work for the first time Further, the co operation of the National Physical Laboratory was sought to consider the question of glassware and, as a result, an extensive schedule of apparatus is appended

Introductory sections deal with the problem of adequate sampling, so essential if the subsequent tests are to be of any value and with the general principles of distillation and of the determination of specific gravity Then follow the methods laid down, under the general headings (1) crude tar, (2) refined tar, including road tar, (3) lower boiling fractions, (4) tar acids, (5) naphthalene, (6) tar bases, (7) creosote oil, (8) crude anthracene and (9) pitch , many of these sections are further subdivided Appendices include, in addition to that on glassware, tables of constants and equivalents and a convenient collection of graphs, some of an elaborate character For general laboratory use, the set of graphs may be obtained separately

No claim to finality is made , indeed, provision is made for the subsequent inclusion of such additional tests as the committee may deem desirable Only those who have been in any way associated with the project can fully appreciate the enormous amount of labour, well repaid, in the production of this book, which may be recommended with confidence to all who have to deal with ' tar products ', much or little Commendation, indeed, is insufficient to such, the volume is a necessity

B A E

The Romance of the Portuguese in Abyssinia an Account of the Adventurous Journeys of the Portuguese to the Empire of Prester John , their Assistance to Ethiopia in its struggle against Islam and their Subsequent Efforts to impose their own Influence and Religion, 1490-1633 By Charles F Rey Pp 319 + 16 plates (London H F and G Witherby, 1929) 18*s* net

IN the volume under notice, Mr Rey tells the story of the endeavours made by the Portuguese nation for a century and a half to secure a footing in Abyssinia This was an outcome of the policy of exploration and expansion initiated by Henry the Navigator When Pedro da Covilham and Alphonso da Payva were sent out in 1487 in search of Prester John, it was not entirely in a spirit of romantic adventure They were also instructed to search out the sources of the wealth of the East and of its commercial products They stumbled, by accident as it were, on Abyssinia , but in the dispatches which they were allowed to send home, though they themselves were never permitted to leave the country, they reported that they had found the legendary kingdom of their search

Mr Rey here tells the story of the subsequent growth of Portuguese influence at the court of the Negus, strengthened as it was by the help which they were able to give the Abyssinians in their resistance to Islam, and of the collapse of both military and missionary adventure which ended in the final expulsion of 1633 Mr Rey's story is well told, with a full appreciation of the bearing of Portuguese policy and its after effects on the fortunes of Abyssinia The book is illustrated by some well-chosen reproductions of old prints.

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Test of a Relativity Postulate

CLERK MAXWELL'S original suggestion, revived in NATURE for April 12, p. 566, was in danger of being lost sight of, although it has been renewed independently from time to time; see, for example, *Phil. Trans.*, 1893, p. 784. The prevailing relativity postulate that motion through the ether is undetectable, or in another form that no motion of an observer can affect his determination of the velocity of light in free space, has not yet been actually and directly verified. Common sense seems to assert that motion of source can have no influence on waves after they have left it, while motion of receiver should subjectively affect their speed of arrival; but this would be contrary to the relativity postulate.

Attempts to observe a relative ether drift, by experiments made on a to and fro journey between terrestrial stations, appear neutralised by a FitzGerald contraction: a first order test is needed; and that can only be furnished by astronomy. The Jovian system is a clock to or from which we are sometimes approaching, sometimes receding; and the consequent essentially Doppler effect (change in satellite periods) is well known. But a Doppler effect, though not caused by a drift, can be modified thereby if the drift is inconstant. Syrens and church bells presumably wail during gusts. The orbital motion of the earth is equivalent to a variation in the drift of the solar system; so there may be an observable modification for the eclipse intervals of Jupiter's satellites. Quadruple satellite motion may be too complicated for the test; that is a question for astronomers: but there is a previous question, the one apparently first propounded by Maxwell; and I do not see that the answer is as yet assuredly in the negative.

If, however, waves are more like projectiles than used to be thought, several lines of reasoning will have to be modified (see, for example, *Proc. Roy. Inst.* for April 1, 1892, or NATURE, vol. 46, p. 497), and the relativity postulate may turn out to be justified by a curious interlocking with the quantum.

OLIVER LODGE.

Normanton House,
Lake, Salisbury,
April 14.

Mechanism in Nerve Centres

IN NATURE of Dec. 14, 1929, there appears a letter from Prof. Alexander Forbes attacking the arguments I have made in criticism of the mechanistic interpretation of reflex functions.[1] I believe this challenge ought to be taken up, because it is both courteous and impersonal in tone and because I fear that the well merited dignity of my critic's name may lend undue weight to his arguments among those who are unfamiliar with neurology.

Prof. Forbes's criticisms are focused on a statement of mine that mechanism cannot account in full for the function of nerve centres because a machine "cannot change itself or its functions to meet new conditions; it does not improve its performance with practice; it cannot perform some particular function depending originally on one part, after that part has been destroyed." Had he proceeded with this quotation he would have added: "An internal combustion engine cannot learn by itself to run as well at a high altitude as at a low. If a motor car turns in at a certain gate 999,999 times, it will have no more tendency to leave the road at that point the millionth time than it had the first. If one cylinder of a motor is put out of action, the speed and power of the engine is reduced in a mathematically predictable proportion; or the loss of a small part in a complicated mechanism may mean the total cessation of function, as in a watch that loses a wheel. Yet these are kinds of things which the central nervous system may do—or do without."

These explanatory examples Prof. Forbes omits: he denies the generalisation and cites other examples from the mechanical world to support his claim. These show, I believe, that he does not understand the difference between living and mechanical processes which constitute the problem under discussion, for he uses changes in the mode of operation in a machine as instances of adaptation. Biologically, adaptation involves the development of a response or of a structure, which has not previously existed in the organism. Prof. Forbes's examples are of changes in mode of functioning of machines that have been designed so to change.

Prof. Forbes first cites the case of a mechanical beetle that turns away from the edge of a table and walks in another direction. His second is the stabiliser of an aeroplane which operates the controls so as to reinstate it on its course when deflected by a 'bump'. A biologist would not regard these as adaptations to new situations because no reaction previously foreign to these 'organisms' has appeared. Perfection of function with practice he illustrates by a motor that runs better after the first 500 miles of use. But this is mere elimination of friction in the bearings, etc., which is, theoretically, part of the process of manufacture and may indeed be accomplished without running the engine at all. 'Running in' does not produce any increase in power generated as would happen were there true perfecting with practice. A true analogy does exist between the regulation of the order of firing in the cylinders of an internal combustion engine and the co-ordination of muscular contractions in the animal body. Both depend on accurate timing, and the better the timing the more power is there produced in both cases. Would an eternity of practice make an engine improve the timing of its explosions?

As to vicarious function in the central nervous system, which means the reappearance of a function that has been originally mediated by some part which is destroyed, Prof. Forbes thinks that "an ingenious mechanic might devise a number of ways in which a machine could be made to change automatically from one mode of operation to another *in consequence* of the failure of some of its parts; for example, a steam pipe might be provided with an automatic valve which, if the pipe burst, would divert the steam through another pipe. Electrical devices which perform essentially this function are actually in use in electric railways." But these are not examples of vicarious functions. The use of the word 'automatic' proves that the mechanisms cited were designed to use alternative parts. After destruction of a 'centre' in the central nervous system, the function previously operating through this part does not automatically reappear in the working of another part. The recovery is slow and laborious: moreover, the parts which take over the function could not have been designed as specific alternative mechanisms. Instances of vicarious function in the brain are notorious, but I will cite one which is more in Prof. Forbes's

field, namely, the spinal cord Lashley[2] has recently shown by double hemisection of the spinal cord that control of the limbs is regained in three months after the permanent interruption of all the long spinal paths from the brain to the motor centres for the limbs It takes three months for the nerve impulses to 'learn' to follow a circuitous route they must travel through path ways the original function of which it was to connect up adjacent centres in the cord If these short fibres were designed as an alternative route for impulses from the brain, they would come into service as soon as the immediate effects of the operation had passed away In man the improvement of function after injury to the spinal cord may go on for years

If one assumes, as do mechanists, that the principles of mechanical and biological functions are identical, the problem of discriminating between them does not arise, and errors, such as those cited above, are quite understandable But Prof Forbes's enthusiasm carries him to more uncritical lengths He devotes his longest paragraph to knocking down a straw man He alleges that I claimed the production of impulses in the central nervous system to be a performance of which no machine could be capable He then argues that machines could do such things With this argument I am in agreement, for it destroys a claim I have never made or contemplated

The reader may, perhaps, think that these are mere debating points and that differences between mechanists and non mechanists are philosophical squabbles without practical significance The very contrary is true, as I think anyone will agree who has studied the way the minds of investigators work Roughly speaking, we find only that for which we seek the hypothesis precedes the discovery The mechanist—in so far as he is faithful to his creed—finds only the mechanical factors underlying the functions he studies and has no further curiosity as to the nature of the functions themselves But for the Pasteurs and Darwins of science, functions, *qua* functions, have had a fascination

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[1] These appear in my book, 'Common Principles in Psychology and Physiology'
[2] *Psychological Review*, vol 37 p 1, 1930

New Data on Cellulose Space Lattice

IN previous investigations made to determine the space lattice of cellulose, the material used was in the form of minute fibres Due to the cylindrical form of the fibres, it was not possible to determine directly by experiment the relations that exist between the planes which are parallel to the long axis of the fibre Several attempts were made to construct a lattice which would fit the diffraction data, but no common agreement was attained[1] The principal difficulty was in the interpretation of the reflections which appeared on the 'equator' in spot diagrams when the X ray beam was perpendicular to the long axis of the fibres, and which appeared in the line diffraction patterns whenever the beam was parallel to the long axis In both cases the planes were evidently parallel to the long axis, but no experimental evidence was available to show how they were situated with respect to one another

New data which clearly bring out that relation were obtained from a plant in which the cellulose is deposited in relatively large sheets instead of in minute cylinders The plant is *Valonia ventricosa* It is a green alga which grows in the form of a single celled hollow sphere often 20 mm in diameter The wall of the sphere is thickened by depositions of cellulose from the inside in thin sheets making the wall many layers in thickness

Line diffraction patterns were made from a layered block composed of many pieces of the wall of this plant The interplanar spacings computed from the lines correspond to those from fibres, indicating an identity of molecular structure in the two forms—sheet and cylinder When pin-hole photographs were made the location of the planes in question was made clear In Fig 1 from fibres and Fig 2 from *Valonia* sheets, the reflections in which we are interested are indicated by the spots lettered A_1, A_2, and A_3 They appear in a row along the 'equator' in the pattern from the fibres, where A_1 and A_2 are partially superposed making a wide spot But in the pattern from *Valonia*, A_1 is 90° from A_2 The former was produced by planes which were parallel to the surface of the sheets, while A_2 was produced by planes at right angles to the surface, that is, the planes reflecting to A_1 and A_2 respectively were at right angles to each other A_3 appeared as four maxima lying between A_1 and A_2 Here for the first time the relation between these three sets of planes seems to be clearly demonstrated In both spacing and angular position the diffraction maxima are in agreement with an elementary cell in which the planes (010) are parallel to the surface of the cell wall and are represented by planes spaced 6 10 A, the planes (100) are perpendicular to the surface of the cell wall and are represented by 5 33 A spacings, and the diagonals (110) are represented by the maxima, A_3, spaced 3 93 A These three interplanar values are probably better values for cellulose than those so far published, because the lines produced by *Valonia* are sharper and more clean cut than those obtained from fibres

FIG 1 —Pin hole diffraction pattern from fibres

FIG 2 —Pin hole diffraction pattern from *Valonia*

The significance of the new data lies in this, that while the c axis only can be determined directly from fibres, the data from *Valonia* make it seem fairly certain that now the *a* and *b* axes also may be experimentally determined and that they are represented by A_2 and A_1 respectively of Fig 2 Based on this new evidence the elementary cell for cellulose is practically as reported by Sponsler and Dore for fibres With the slight refinement of measurements, made possible by *Valonia* diffraction lines, the axial dimensions for cellulose are

$$a = 10\ 7\ \text{A}\ ,\ b = 12\ 2\ \text{A}\ ,\ c = 10\ 3\ \text{A}$$

The angles between them are within 2° or 3° of right angles

Complete details of the work with *Valonia* will be submitted elsewhere

O L Sponsler
University of California at Los Angeles

Prof Sponsler is to be congratulated on his discovery of a plant in which the cellulose crystals are arranged so favourably for X ray analysis The results help to place the determination of cellulose structure on firm ground Prof Sponsler does not refer in his list of papers to certain attempts that have been made to produce artificially the same sort of special arrangements as he has now found in *Valonia* For example, Mark and Susich, having prepared a sheet from tunicin and having stretched it in one direction, were able to obtain an X ray diagram of the same character as that of Prof Sponsler's Fig 2 (*Zeit f phys Chem*, 4, p 433, Fig 3D, 1929) They, as Prof Sponsler does, deduced that the planes with spacings 6 08 and 5 45 (Sponsler 6 10 and 5 33) were nearly at right angles to one another, while the plane with spacing 3 95 (Sponsler 3 93) was inclined at about 45° to each of the others

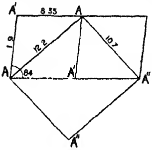

Fig 1

Prof Sponsler describes the cell as nearly orthorhombic with axes 10 7, 10 3, 12 2 The description of Mark and his collaborators is

$$a = 8\ 35,\ b = 10\ 3,\ c = 7\ 9,\ \beta = 84^\circ$$

The two descriptions, though they differ apparently, are almost equivalent The identity period along the fibre is the same in both, namely, 10 3

Prof Sponsler's cross section is $A\ A\ A''\ A''$ in Fig 1, that of Mark and others is $A\ A'\ A\ A'$ In the former case, A and A'' represent molecules or molecular chains in similar positions, with A' differing somewhat In the latter case, all the A's are identical The larger cell contains twice as many molecules as the smaller

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[1] Polanyi *Naturwiss* 9, 228 1921 Sponsler *Jour Gen Physiol*, 9, 221 233 1925 and 677 695, 1926 Sponsler and Dore Colloid Symposium Monograph 4 174 202 1926 Herzog *Jour phys Chem* 30, 456 467 1926 Andress *Zeit f phys Chem* 136, 279 288, 1928 Mark and Meyer *Ber d D Chem Gesells* 61, 593 614 1928, and *Zeit f phys Chem* B 2, 115 145, 1929

Pressure Effects in the Band Spectrum of Calcium Hydride

Some years ago Mulliken (*Phys Rev*, 25, 509, 1925) reported a band in calcium hydride (CaH) at λ3533, having a very unusual structure The band was photographed at low pressure (~40 mm hydrogen) and is composed of single P and R branches, which are abruptly cut off at P (11½) and R (9½) As no more bands appeared corresponding to any higher vibrational states in the molecule, the effect was interpreted as a manifestation of some very unstable conditions in the initial C state Indeed, it was later supposed that the molecule dissociates by pure rotation, and Franck and Sponer (*Gött Nachrichten*, 241, 1928) calculated the dissociation energy of the C level to be about 0 09 volts

In connexion with some work on the pressure effects in band spectra at present going on in this laboratory, we undertook an investigation on this rather interesting band, varying the hydrogen pressure in the arc from 10 mm of mercury up to seven atmospheres We found that the entire spectrum of calcium hydride was brilliantly increased with the pressure In the C band a very remarkable effect appeared At high pressure, the P and R branches were strongly developed to about $J \sim 40$, the first few lines above the critical value $J = 10\frac{1}{2}$ being somewhat diffuse In addition, a number of new bands appeared, apparently forming a band system, the vibrational quantum numbers (v' v'') of which are here given

Heads of Bands in λ (Air)

v'' \ v'	½	1½	2½	3½	4½	5½
½	3533 6	3367 6				
1½	3696 6	3515 4	3356 3			
2½			3498 1	3346 5		
3½				3482 0	3337 6	
4½						3330 8

The correctness of this scheme has been checked by a comparison with other band systems in calcium hydride having a common final state $^2\Sigma$ There are numerous interesting details in the pressure effects on the C bands, for example, the appearance of some diffuse doublet components of the P and R series, apparently forming the missing components to be expected in a $^2\Sigma - {}^2\Sigma$ transition A complete description, including the analyses of new band systems in the visible and the near infra red, will, however, be published later

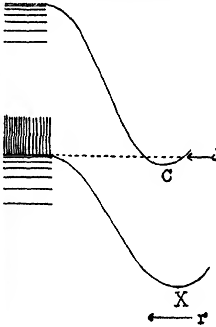

Fig 1

From the observations mentioned above, the following conclusions may now be drawn The abrupt cut off in the C band at low pressure is not due to an extremely small D value of the C level, but must be caused by perturbing influences from some unknown electronic level X, as shown in Fig 1 The effect is considered as a predissociation of the C-state into the

continuous region above this X level. One is tempted to say that the unusual band of Mulliken appears in the spectrum only due to the dipping of the C level into the region of discrete *Eigenwerte* in X. According to the theory of Kronig (*Zeit. f. Phys.*, **50**, 347; 1928) the Λ of the perturbing X differs from that of the C level by zero or ± 1. The C level is interpreted as a $^2\Sigma$ state ($\Lambda = 0$), so the X level must be either a $^2\Sigma$ or a $^2\Pi$ state ($\Lambda = 1$). The nature of the effect—the appearance of a great number of additional lines at high pressure—leads us to adopt the first of these alternatives as the correct theory.

Pressure effects of similar character, although due to interactions between Π and Σ states, have recently been reported by E. Bengtsson and R. Rydberg (*Zeit. f. Phys.*, **59**, 540; 1930) in the spectrum of aluminium hydride. Mr. G. Stenvinkel has interpreted this effect in terms of Kronig's theory. His hypothesis is readily applied to the effects in calcium hydride, so that we may refer to his paper (*Zeit. f. Phys.*, in press) for further details in the mechanism of the pressure effects.

B. Grundström.
E. Hulthén.

University of Stockholm,
Mar. 17.

The Absorption Spectrum of Vitamin D

In 1929 we published evidence (*Proc. Roy. Soc.*, B, **104**, 561; 1929) showing that in preparations made from ergosterol by exposure to ultra-violet radiation, and subsequent removal of unchanged ergosterol, there was a close correlation between antirachitic activity and intensity of absorption for radiation of wave-length 280 mμ. On this and on other evidence we argued that it was probable that vitamin D was the substance present in these products which was responsible for the intense absorption band with heads at 280 mμ and 271 mμ (substance A). We have now obtained definite evidence that this inference is not correct, and that the reactions which occur on irradiation of ergosterol are more complex than then appeared probable.

We have succeeded by the use of light filters and other methods in obtaining preparations showing very high antirachitic power but relatively low absorption at 280 mμ. Further, by irradiating ergosterol with radiation only of wave-lengths longer than 280 mμ (through a filter of xylene), removing the unchanged ergosterol and re-radiating with short wave-lengths only (through filters of chlorine and bromine), we have often obtained during our second radiations a considerable rise in absorption at 280 mμ simultaneously with a destruction of antirachitic activity. In this way we have obtained mixtures showing high absorption closely resembling that which we defined as due to substance A (and almost certainly due to this substance) but showing only low antirachitic activity.

Thus, while it is not yet possible to say what is the true absorption of vitamin D, it is evident that the substance showing the very intense maximum at 280 mμ produced in the early stages of the irradiation of ergosterol by a mercury vapour lamp (without light filters) is not vitamin D.

This non-identity of the two substances is in agreement with the findings of Reerink and Van Wijk (*Biochem. Jour.*, **23**, 1294; 1929) and Windaus (*Nachr. ges. Wiss. Göttingen*, 36-57; 1930).

R. B. Bourdillon.
R. G. C. Jenkins.
T. A. Webster.

National Institute for Medical Research,
London, N.W.3,
April 10.

Presence of a Yeast in the Death Watch Beetle (*Xestobium rufo-villosum* De G.).

My attention has been directed to the paper by Campbell in the *Biochemical Journal*, vol. 23, No. 6, 1929, in which reference is made to the work of Uvarov (1928), who suggests that wood-eating insects may partially digest wood particles with the aid of the secretions or excretions of micro-organisms, or even digest the micro-organisms themselves. Campbell, as the result of his work, suggests that it is probable that intestinal micro-organisms play a prominent part in the biology of the larva. In view of these suggestions, it is thought to be of interest to direct attention to the fact that, whilst conducting an investigation under the direction of the late Prof. H. Maxwell Lefroy during 1924, I found that a yeast was invariably present in larvæ and adults of the death watch beetle. While no evidence was obtained that the yeast was actually concerned in the digestion of wood particles, a number of facts concerning the distribution of the yeast in the various stages of the insect was determined. Dr. S. G. Paine, of the Imperial College of Science, was also closely concerned with the investigation and made a number of attempts to cultivate the yeast.

Briefly, the facts ascertained with regard to the yeast were as follows:

1. Yeasts were found in large numbers in the hepatic diverticula and closely connected portions of the alimentary canal of the adult male and female insects, and also in the larvæ. They are enclosed within the cells of the hepatic diverticula of young larvæ, but free in the diverticula of older larvæ and of the adult insects.
2. Yeasts are extremely rare in portions of the alimentary canal other than those mentioned above.
3. Yeasts are to be found in large numbers in the spermathecæ and vagina of the adult female, from whence they are doubtless conveyed to the eggs.

Unfortunately, when I left the Imperial College to take up my present appointment, the work had to be discontinued. An important fact, which still requires elucidation, is the means whereby the yeasts migrate from the hepatic diverticula, in the larva, to the spermathecæ of the adult female. It would seem that this can only take place in the pupal stage, during histolysis. The yeasts also require tracing from the egg to the newly hatched larva.

It is hoped that the observations here recorded may be of assistance to those endeavouring to elucidate the metabolism of the death watch beetle.

L. N. Staniland
(Advisory Entomologist).

University of Bristol Research Station,
Long Ashton, Bristol.

Integration of Sunlight

In their letter on this subject in Nature of Mar. 22, p. 447, Messrs. Teegan and Rendall refer to a photo-electrolytic method. The electrolytic method of integration does not appear to be very sensitive.

For investigation of the flow of heat at a window, into or out of a room, apparatus has been devised which produces an electromotive force of 70 micro-volts for a heat flow of one British thermal unit per square foot per hour and affords a continuous record of the flow. This has been described in the *Philosophical Magazine* (**8**, 841, December 1929).

With intermittent sunshine the continuous record is naturally difficult to integrate and an integrator has therefore been devised to 'meter' the heat flow

This instrument works from A C mains and operates a six-figure counting train, one unit corresponding to one microvolt hour The integrator is arranged to handle electromotive forces ranging from −150 to +300 microvolts A description of the apparatus is being prepared for publication

A F DUFTON
Building Research Station,
Garston, Herts, Mar 24

Method of Registering Multiple Simultaneous Impulses of Several Geiger's Counters

PROF W BOTHE in the *Zeitschrift fur Physik* (vol 59, p 1) describes a method for registering simultaneous impulses of two Geiger's counters, which depends principally on the working of a two grid thermionic valve Lately, I have had the opportunity of experimenting with a circuit which perhaps is simpler and at the same time has the advantage that it can be extended also to the registering of triple simultaneous impulses or even more The circuit adopted (for triple coinciding impulses) is shown in the accompanying diagram (Fig 1)

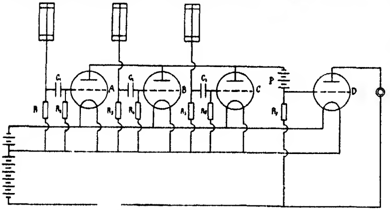

FIG 1

$$R_1, R_3, R_5 = 5\times 10^9 \text{ ohms}$$
$$R_2, R_4, R_6, R_7 = 8\times 10^6 \text{ ohms}$$
$$C_1, C_2, C_3 = 10^{-4}\ \mu F$$

The positive electrodes of the three counters (in my experiments I have used Geiger's wire counters) are electrostatically coupled to the grids of the three valves A, B, C In normal conditions these grids have a zero potential, whenever a discharge occurs they become negative, thus interrupting the current flow

As the resistance R_7 is very great compared with the internal resistances of the valves A, B, C, their anodes are at a potential near to zero The grid of the valve D (for the introduction of the auxiliary battery P) is at a slight negative potential This potential varies very little when only one or two counter tubes are working, while it undergoes a sudden rise when, for the simultaneous working of the three counter tubes, the current is interrupted in all the three valves

The consequent variation of the anode current (eventually amplified by a fifth valve) is acoustically detected by a telephone

The circuit arrangement, in regard to the counter tubes, is perfectly symmetrical, a condition which is not fulfilled in the circuit of Prof Bothe, because the grids of the two-grid valve have rather different characteristics

It appears that the triple coincidences method is the only one available for studying the form of the paths of cosmic rays, and I mean to employ it in experiments on the magnetic deviation of these radiations

BRUNO ROSSI
Physical Institute of
the University of Florence,
Arcetri, Italy, Feb 7

The Conversion of α Benzilmonoxime into the β Oxime by Animal Charcoal

DURING the course of an investigation into the properties of the isomeric monoximes of benzil, we have made the following somewhat startling observation

We have been able to devise a method for estimating mixtures of the α and β oximes and have shown that the α oxime shows no appreciable change into its isomer (which is the more stable of the two) in solution in alcohol or benzene at 50° in a period of thirty six hours, and that the change is not accelerated by acids or alkalis when present in small concentration On the other hand, if a benzene solution of the α oxime is boiled with animal charcoal for a few seconds, the change is complete and no α oxime can be detected in the solution

Finely powdered soft wood charcoal and powdered silica gel showed no such effect, the α oxime being recovered unchanged Finely divided calcium phosphate is also without action That the conversion does not arise from the action of catalysts dissolved from the charcoal by the benzene is shown by boiling some benzene with animal charcoal, filtering off the charcoal, and using the filtrate as a solvent for the α oxime, there is no conversion into the isomer

This observation suggests that care should be exercised in the use of animal charcoal as a decolorising agent in the purification of isomers of the type of this α oxime A full account of our work on this subject will be published later elsewhere

T W J TAYLOR
SALLY MARKS
The Dyson Perrins Laboratory,
Oxford, Mar 17

Fluorescent and Phosphorescent Substances

SUBSTANCES which fluoresce strongly under the influence of X rays are barium and magnesium platinocyanides and cadmium tungstate The formulæ of these compounds, as given by Werner, are as follows

$$[Pt(CN)_4][Ba(H_2O)_4],$$
$$[Pt(CN)_4][Mg(H_2O)_7],$$
$$[WO_4]Cd$$

An atom of high stopping power with four light atoms or radicals arranged about it, perhaps tetrahedrally, and a bivalent positive ion, are present in all

With the first part of the formulæ may be compared the structure of zinc sulphide and diamond, which phosphoresce in X rays, phosphorus and yellow arsenic exhibit phosphorescence on oxidation, and arsenious oxide is luminous on crystallisation from acid solution

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University of London, E 1

The Medical Research Council *

IN the fifteenth annual report of the Medical Research Council, the opportunity is taken to review the progress of the past five years as well as the work of the year 1928–29 Certain changes in the composition of the Council occurred during the year the late Lord Balfour resigned the chairmanship and was succeeded by Lord D'Abernon Sir Charles Trevelyan, Prof E P Cathcart, and Sir Charles Sherrington retired, and were succeeded by Major A G Church, Prof J J R Macleod, and Mr W Trotter

The financial resources of the Council have again been augmented by donations from private benefactors and various public bodies at the same time, grants have been made to numerous workers at university and other centres of research and the laboratory facilities provided by these authorities have indirectly extended the resources of the Council In addition to appointing annually suitable workers to the Rockefeller Travelling Medical Fellowships, the Council during the past year has received a donation from Mrs Odo Cross for the endowment of research fellowships for the study of tuberculosis

The title of the Industrial Fatigue Research Board has been changed to the Industrial Health Research Board, since its investigations are now chiefly directed towards problems other than fatigue as such Among other changes in the constitution of the Board, Lord D'Abernon has retired from the chairmanship and has been succeeded by Sir Arnold Wilson

The report points out that at no time has a capital grant been made to the Council for the provision of laboratories and equipment the National Institute and the field Laboratories have been acquired and equipped out of income The former was bought in 1914 out of monies derived from non expended income in the first year of work before any awarded grants became effective during the War, the building reverted to its original use as a hospital, after the War, scientific equipment for the Institute and a freehold site of nearly 40 acres at Mill Hill were acquired out of savings accumulated during the War Further equipment has been gradually provided out of income, a laboratory building at the farm from a bequest by the late Miss O H Stubber, and during the past year a much-needed extension to the Institute from a bequest by the late Lord Justice Ronan The latter was designed to give the highest standard of hygienic conditions for the keeping of experimental animals its completion brings the National Institute as a whole, including the Farm Laboratories, to a stage of development which may be expected to provide all the main requirements for the research work centralised here for many years With the increase in accommodation provided by this extension, it has now been possible to remove the unsightly huts from the grounds of the Institute

One of the most important functions of the Council is the establishment, maintenance, and distribution of standards for certain remedies, the activity of which can only be measured by biological methods This work involves the preparation of stable standards and the determination of suitable methods of biological assay, as well as the checking of the activity of new preparations of the standard, especially in terms of an international standard, where such exists The following national standards are required to be kept at the Institute under the Therapeutic Substances Act 1927 diphtheria antitoxin, tetanus antitoxin, anti dysentery serum (Shiga), tuberculin, insulin, pituitary posterior lobe, arsenobenzene, novarsenobenzene, and sulpharsenobenzene All these are based on the international standards, of which those for tuberculin and insulin were actually prepared at the Institute The international standards now held there for maintenance and general distribution are those of insulin, sulpharsenobenzene, digitalis, and ouabain National standards for the two latter are available for distribution when any authority shall require them The only commercial products which are now regularly tested at the Institute before issue are the drugs of the arsenobenzene group, but samples of the other scheduled substances prepared by the manufacturers and assayed in terms of the standard are periodically tested to see that they fulfil the specified requirements of potency, sterility, etc

The fact that most of the research work supported by the Council is conducted in the laboratory raises the question, Is there a science of experimental medicine, of which the material for study is the human patient? Clinical research can only rarely be carried out by a practising physician his work is to diagnose the condition from which the patient is suffering and to treat it, for which he must have a wide knowledge and experience of disease The advancement of scientific knowledge cannot be his primary object The clinical research worker, on the other hand, can devote his attention to one particular disease or group of diseases, and need not maintain his knowledge and skill at concert pitch over the whole clinical field He must tend to ignore the individual patient and study the disease process as such by experimental methods, whether at the bedside or in the laboratory Again, it is clear that the teaching of general medicine is incompatible with a whole time devotion to the study of one small corner of this field It is for this reason that the clinical 'units' set up in certain teaching hospitals have been unable to carry out much research work although they have served as excellent centres for the teaching of clinical medicine

Fifteen years ago the Council set up a clinical 'research unit' at University College Hospital, London, appointing Dr (now Sir) Thomas Lewis as whole time director and providing adequate personnel and facilities for his work The success of this experiment answers the question asked

* Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the year 1928–29 (London H M Stationery Office, 1930) Price 3s net

above there is a science of experimental medicine The work of Sir Thomas Lewis and his collaborators on the heart and vascular system, its disorders and their treatment, has constituted the central stream of progress made in these subjects during the past decade For similar advances in other directions it is essential to recruit clinical research workers, but men will not be attracted without the possibility of some definite post in clinical research being available to them in the future, which is not the case at present The Council therefore proposes to increase the number of clinical workers upon its permanent staff as soon as suitably-trained candidates who have shown their aptitude for this type of research are available Meanwhile, the Council is prepared to encourage young workers to test themselves in this branch of medical research with the view of its becoming their life-work

The vascular response of the skin to injury has been further investigated during the year The vessels in the frog's tongue react to injury in the same way as those of the human skin, but do not respond to histamine A substance, probably a base of the histidine-arginine series can, however, be extracted from frog's skin which will reproduce the vascular reactions of injury not only in the frog's tongue, but also in the human skin (Grant and Jones) This result confirms the previous conclusion that the reaction to injury consists essentially in the liberation from the cells of the skin of histamine or some similar substance Similarly, the demonstration that acetylcholine can be isolated from the spleen is evidence in favour of its actual liberation in the tissues following certain kinds of nervous action, when the results of such nervous stimulus can be duplicated by the injection of acetylcholine (Dale and Dudley)

In this review it is impossible to refer to more than one or two of the other researches which have been carried out by members of the scientific staff of the Council or by independent workers helped by grants-in-aid abstracts of these researches, together with references to published papers, are given in the report Work on virus diseases has been continued the difficulty of making rapid progress is due to the fact that they cannot yet be grown on artificial media, although some will grow *in vitro* in the presence of a piece of surviving tissue The present position with regard to viruses is rather like that facing bacteriologists fifty years ago before adequate methods of microscopic study and cultivation had been worked out More progress has been made in the devising of methods of immunising animals to these diseases, and it is now possible to immunise dogs to distemper, fowls to fowl plague, and monkeys to yellow fever

Research on chemotherapeutic agents is being actively pursued certain aromatic amides containing arsenic have a pronounced curative action in some types of trypanosomiasis, as well as some new styryl compounds the latter are being tested against trypanosomiasis of cattle in Tanganyika Territory

Finally, among other subjects referred to in the report may be mentioned work on cancer and radium, anæsthetics, the vitamins, and the physiological actions of different types of light

The Deutsches Museum, Munich

THE Royal Commission on National Museums and Galleries in its Final Report, of which, as a whole, we had something to say in our issue of Feb 1 (p 153), deals with individual institutions We are particularly interested in those which are wholly or partly of a scientific character, and we notice that the Commissioners in dealing with the Science Museum direct pointed attention to the Deutsches Museum von Meisterwerken der Naturwissenschaft und Technik, to give it its full title, " not only because it is in itself a remarkable example of how a modern Museum can be made a great instrument of technical as well as of popular instruction, but because it is a symbol of national efficiency It reveals the intense concentration in the Germany of to day on the scientific means of industrial progress, a concentration which we believe has its sharp significance for this country " We are pleased, by the way, to see that the Commissioners commend to the nation the scientific attitude of mind, for it is one that we try year in and year out in these columns to inculcate

Perhaps, then, we can scarcely do greater service to our readers than to place before them a brief account of the Deutsches Museum Its aim is stated succinctly and correctly in the words of the Report to illustrate " the development of research and discovery of every age and of all countries, an Institution in which the results of scientific research and experiment should be fully shown But beyond this another purpose has been kept in view The Museum is to be a great instrument for the education of the visitor He must not only be informed by studying the exhibits as to the growth and progress of a subject, but as far as possible he must be put into a position to realize and verify, through experiments performed by himself, the steps by which the progress has been achieved " Such is the example held up to us for emulation

A short account of the Museum was published in NATURE in 1925 (Vol 115, 611), when the Museum was about to be formally opened, and it is unnecessary, therefore, to repeat the history beyond saying that the institution, contrary to what one might expect in Germany, is neither State owned nor State governed It owes its inception and management up to the present to Dr Ing Oskar von Miller, a distinguished electrical power engineer, and it is an open secret that the idea of forming a museum of this kind was implanted in his mind when, as a young man, he visited the Loan Collection of Scientific Apparatus at South Kensington in 1876 He pondered the idea for more than a quarter of a century until he felt able to put his

plans before the technical and scientific public of Germany The scheme was approved unanimously and work was at once commenced in temporary premises The permanent building, of a model of which, prepared last year, we give an illustration (Fig 1) kindly supplied by Dr von Miller, together with a ground plan (Fig 2), from the same source, is magnificently situated on an island in the River Isar, on which the city of Munich stands The Museum was opened with almost princely splendour on May 7, 1925, the seventieth birthday of the founder and director

The building is rectangular in plan, 345 feet by 325 feet, and the whole of the area on the ground floor is given up to exhibition space, side and top lighted The basement, of the same extent, is professional men received no fees, and the workmen even worked on Sundays for nothing The result is a building estimated to have cost 1½ million pounds

The Museum galleries are subdivided by partitions into spaces each sufficient for the section concerned, which is thus marked off from the rest, at the same time affording space for wall cases or diagrams In museum fittings there is no rigidity, everything seems designed to suit the particular circumstances

On the first floor over the entrance is a Hall of Fame, where memorials to the great men of science are set up This human touch is everywhere, for lesser men are commemorated in the sections where their labours are recorded On the second floor is a reading room with a supply of technical literature

Museum Building 387,504 sq ft. exhibition floor space
Library Building, with bookcases, read ing rooms, and stacks for one million volumes
Congress Hall building with accommodation for 2000 persons
Connecting building with restaurant
Connecting building with two lecture halls for 200 300 persons

Fig 1 —The Deutsches Museum, Munich

taken up partly by exhibits, partly with workshops and the necessary museum services A sub-base ment is used to set out coal, mineral, and salt mines On the first floor the building is brought to the form of a hollow rectangle with a median gallery, which in common with the two galleries parallel to it are 68 ft wide, the galleries at the ends are 57 ft wide The second, third, and fourth floors are repetitions of the first without the median gallery At the south west angle is a noble tower used for a barometer and lift At the north-east angle a fifth and a sixth floor have been built for astronomy In all there is a grand total of 387,000 sq ft of public floor space Both electric heating and lighting are supplied free by the city of Munich from a transformer station fed from the great Walchensee grid supply, in the origination of which von Miller himself was largely concerned

The way in which the building was carried out, mainly in the post-War period of financial instability, reads like a romance The aggregate for the reinforced concrete came from the bed of the river, the cement, stone, wood, and steel were given, the and there are four bookstalls There are also two refreshment rooms

'Interiors' affording a further human touch are a great feature These take a variety of forms, for example, a scythe forge of 1803 from the Black Forest, a copy of a Swiss watchmaker's shop with its hand tools, side by side with a portion of a modern factory with machine tools, for comparison, an actual paper mill of the eighteenth century, reproductions of an alchemist's and of an eighteenth century chemist's laboratory, a scriptorium with a monk copying a missal, a fine salon containing the old musical instruments, with a musician in attendance to play upon them

Interiors of a different order are the two planetaria in the Astronomy Section We need mention only the Ptolemaic one, by an optical projection apparatus images of the fixed stars of the northern hemisphere are thrown on the domed ceiling of a darkened room and the motion of the heavens during twenty-four hours can be reproduced in the space of four minutes Further, by another projection apparatus, in conjunction with gearing like an

orrery, the images of the sun, moon, and planets can be thrown on the same dome, and their motion during a whole year reproduced in five minutes The effect is thrilling and created a furore in Germany, with the result that planetaria have been installed by many of the larger cities

Since the main function of a museum as usually understood is to conserve objects, we find a great feature made of collections of original apparatus and MSS of famous workers in science The wealth of material under this head is remarkable when it is considered how loth to part with it must have been the institutions in which it had hitherto been preserved It is a tribute to von Miller that he has been able to deflect the policy, only too frequently pursued, of the 'dog in the manger'

Were there nothing further in the Museum than what we have cited above, we should describe it as an advanced institution of its kind, but little more We find, however, another feature, and the outstanding one, and that is its direct educational purpose Everywhere, and more particularly in the Physics Section which has been longest in being and is presumably most mature, the visitor finds experiments described in modern text books so arranged that he can perform them by himself or with the aid in some cases of an obliging attendant He can demonstrate natural laws and reproduce some of the more striking results of modern physics The dictum of Goethe has been acted on "Es ist nicht genug zu wissen, man muss auch thun" For example, in acoustics the gradual development of our knowledge of sound vibrations is brought out by experiment The formation of the voice, the action of the ear, the phonograph and gramophone are made clear with working models In a specially designed room are experiments to hand on the composition and resolution of musical notes In optics, again, for example, defects of vision are shown by four models of an eye viewing illuminated objects at a distance In each case the retina is transparent, and the visitor sees from behind the images of the objects projected on it The first eye is normal, by a slight adjustment of the lens in the eye the near or far distant object can be focused The second eye is short-sighted, the near object is distinct, the far object is brought into focus by interposing a concave lens The third eye is long-sighted for the near object, a convex lens has to be interposed The fourth eye is astigmatic and a cylindrical lens is required for correction Would any person after seeing this exhibit wear spectacles picked up at random ?

In aeronautics is a small working wind channel where, with the aid of an attendant, the lift and resistance of solids can be measured on sensitive direct reading balances Selected objects that have the same resistance but are very different in shape, for example, a circular disc and a model of an air ship, are tried successively In section after section one comes across similar experimental apparatus

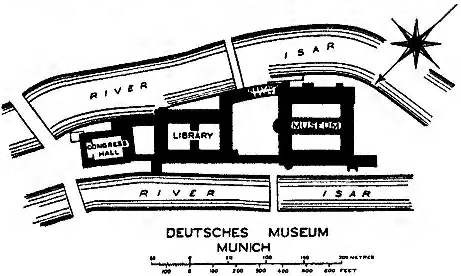

Fig 2

There are other activities that we noticed, such as the guide lectures twice daily in the galleries These are so arranged that practically the whole of the collections are covered in the week Lantern and film lectures are given in the afternoons

This, however, is far from completing the story, for von Miller had the further conception of a vast library to contain MSS and books on science, periodicals, drawings, diagrams, portraits, photographic films, lantern slides and catalogues, in fact to constitute a record office of the march of science, a storehouse of garnered knowledge and of material upon which further research can be made The Museum really only presents in an assimilable form an epitome of what will be found eventually in the Library This conception is taking shape rapidly, and the building, adjoining the Museum, yet integral with it architecturally, is being pushed on rapidly so that it may be opened next month From what has just been said it will be seen that the Library is much greater in extent than the Museum

Beyond the Library building must be mentioned the Congress Hall with accommodation for 2000 persons This is provided with arrangements for lantern, silent and sound film projection, as well as for scientific demonstrations

The building that joins the Museum to the Library has restaurant accommodation, and in the corresponding building between the Library and the Congress Hall are two lecture rooms with

accommodation for 200 300 persons, principally intended for schools and institutions

As one traverses the galleries and muses on the complexities of civilised life and how little the great bulk of our populations realise, much less understand, the nature of the network of social activities upon which their very existence depends, to say nothing of the conveniences and amusements with which they are surrounded, one cannot help thinking that wise statesmen would see to it that museums such as this should be established in every large territory and that visits to it should be part of the duties of citizenship Judging from our own reaction to the Museum, it fires the imagination, arouses the creative or inventive instinct, deepens the sense of responsibility to one's fellows and leads to a determination to add if possible to the common weal

What lessons has the Museum to teach us, particularly in regard to developing the Science Museum at South Kensington? Let us remember that it was in Great Britain three quarters of a century ago that the idea originated that a museum must not be a storehouse merely, but also a direct means of education Without slavish copying, and bearing in mind the serious limitations imposed by the nature of the present site at South Kensington, we suggest that considerable extension of the experimental apparatus should be made Further, that the human note should be sounded by paying greater attention to the lives of the great men who have left their mark on this age of ours The addition of interiors, again giving the human touch by showing man in his environment at different periods, is eminently desirable A planetarium should be installed even if the necessary large outlay —£20,000—upon it should have to be recouped by a special charge for admission

It is no use complaining of the attitude of the public towards science, that attitude can be changed for the better if we bring science to the public The success of the Science Museum, judging by the attendances since the present building was opened, shows that response is immediate

Obituary

Prof J O Arnold, F R S

PROF ARNOLD, whose death occurred on Mar 27, must be regarded as one of the founders of the modern metallurgy of steel It was largely through his efforts that the scientific control of manufacture by chemical analysis and microscopical examination has been generally adopted in the steel industry, whilst his researches have played a most important part in building up our knowledge of the constitution of the alloys of iron In both these directions he rendered great services to science in general, and to the industry of his adopted city of Sheffield in particular

John Oliver Arnold was born at Peterborough on Dec 29, 1858, his father being an engineer by profession He was educated at King Edward VI School, Birmingham, and entered the navy as a cadet, but quitted it after a voyage to India, becoming a works chemist at a time when few steel works had such men on their staff His naval experience left him with a strong love of the sea, and he remained an enthusiastic yachtsman to the end of his life, although the restrictions of the War period compelled him to leave the stormy seas of the west coast and to confine his sailing to the waters of Windermere

In 1889, after eleven years as a works chemist and consultant, Arnold was appointed professor of metallurgy in the Sheffield Technical School, and here he continued to work until his retirement through ill health in 1920, the Technical School having meanwhile become a part of the University of Sheffield, with a separate Faculty of Metallurgy, of which Arnold was appointed Dean On his retirement he was nominated emeritus professor His work during thirty-one years was intimately bound up with the progress of the Department of which he was the head, and its interests always stood first in his activities He had to create the demand for trained men in the steel industry, and his enthusiasm enabled him to achieve great success in this direction, so that he had the pleasure of seeing his old students occupying leading positions in industry, and themselves carrying out researches in his favourite science

On the scientific side, Arnold's work followed on that of Sorby, whose friend and disciple he was He became convinced of the value of Sorby's use of the microscope in the study of steel, and himself did much to perfect the technique of metallography, whilst his discoveries were made by a skilful combination of chemical and microscopical methods It is remarkable that for many years he made little use of photography in recording the structure of metals, but preferred drawings, many of which were executed with wonderful skill and patience by members of his staff He was always inclined to prefer a chemical explanation to one which depended on more obscure physical changes, as in his long controversy concerning the causes of the hardness of steel, which he maintained to be due to combination with carbon rather than to the existence of allotropic modifications of iron The two schools have become reconciled since, but it is impossible to read the earlier papers without realising that Arnold was always close to experience, and that his arguments were invariably based on practical knowledge of the behaviour of steel in the laboratory and in the works His descriptions of troostite and of what is now called martensite show a remarkable insight, although the terms in which he described the structures often seemed to differ from those in general use He also added much to our knowledge of the influence of impurities on steel

Arnold was closely connected with the development of high-speed tool steels, and in this matter he had the closest confidence of the manufacturers It was due to him that vanadium was adopted as a constituent of the highest class of such steels,

whilst his long series of papers on the carbides threw much light on the influence of alloying elements in special steels He was frequently involved in controversy, and appeared to enjoy it, his vigorous personality and his command of picturesque English lending interest to his frequent interventions in the discussions of the Iron and Steel Institute He was elected a fellow of the Royal Society in 1912, and was awarded the Bessemer medal of the Iron and Steel Institute in 1905 Of fine presence and genial manner, a good talker with a fund of humour, he was devoted to the interests of his students and was loved by them He has left a vivid impression on all who knew him, and his place in the history of metallurgy will be a high one C H D

Sir Edward Brabrook, C B

We regret to record the death of Sir Edward W Brabrook, which took place in his ninety first year at Wallington, Surrey, on Mar 20 Within the space of one week, two prominent survivors of the Victorian Age in the learned world, Edward Clodd and Edward Brabrook, passed away at an advanced age They had much in common both were men of affairs, both were interested in anthropological studies, especially folk lore, and both were members of the circle in which were Huxley, Avebury, Sir John Evans, Pitt Rivers, E B Tylor, and others upon whom in the latter half of the last century fell the burden of winning for anthropological studies an independent and recognised place in the academic and scientific world It was only in 1884 that anthropology was granted a separate section at the annual meeting of the British Association In this struggle—for it was little less—Brabrook took his full share

Edward William Brabrook was born in Cornhill, London, on April 10, 1839 He was educated at the school of Mr William Pinches, Bell Alley, Lombard Street, and then entered an insurance office, but in 1869 he was appointed Assistant Registrar of Friendly Societies Later he was called to the Bar A Civil Servant of the best type, his official career calls for little comment He was appointed Chief Registrar in 1891, and retired under the age limit in 1904, having been created C B shortly before and receiving the honour of knighthood on retirement A recognised authority on the subject of thrift, his writings on friendly societies and State insurance, and particularly his review of the progress of friendly societies down to 1914, which appeared in the *Journal of the Statistical Society*, are classics in their field, even though the author adhered to the idea of 'self-help' at a time when in practical politics the view of the responsibility of the State had ceased to be restricted by that principle

Brabrook's activities were by no means confined to his official duties Indeed, it was outside the range of those duties that he was best known and perhaps will best be remembered He was a man of many friendships, and these lay where his intellectual interests called him—in the learned world, and especially in the world of anthropology and archæology In 1860 he became a fellow of the Society of Antiquaries, and soon after the foundation of the Anthropological Society by Sir Richard Burton and George Hunt in 1863, as the result of a split in the Ethnological Society, he became the director or honorary secretary of the newly formed body He thus came to take a share in the controversies and discussions between the two divergent views on the scope and methods of anthropological science which were finally composed by the foundation of the Anthropological Institute of Great Britain and Ireland in 1871 In this, as in the many other societies he helped to found, and in the work of which he took an active part, Brabrook's position was unique By his knowledge of procedure and of the technicalities relating to associations "not trading for profit", he was able to guide them through the difficulties of their early days, while his interests over a wide field of research, combined with his abilities and experience as an administrator, made him an invaluable aid in the promotion of combined action in scientific studies which led to the publication by the British Association of "Notes and Queries on Anthropology" and to proposals for anthropological and ethnographical research in Great Britain and in the dependencies, some of which have since borne fruit, while others, unfortunately, are still the objects of desire of the anthropologists of to day

It was these qualities, as much as his scientific knowledge, which made Brabrook a valued member of the governing bodies of the Anthropological Institute, of which he was director in 1873 and president in 1895–97, of the Folk-Lore Society, founded in 1878, of which also he was president in 1901–2, of the Child Study Society, of the Eugenics Education Society, and of the Rationalist Press Association In 1898 he was president of Section H (Anthropology) of the British Association at Bristol, an occasion made notable by the appearance of de Rougemont, and in 1904 he was also president of Section F (Economic Science and Statistics) So late as 1920–21 he was president of the South Eastern Union of Scientific Societies

Apart from subjects related to his official duties, upon which he wrote three books, Brabrook's voluminous writings are, for the most part, scattered in the publications of the many societies to which he belonged, but he wrote a history of the Society of Literature, several legal treatises, and a history of the dining club of the Society of Antiquaries, of which he had long been a member

Prof Eugenio Rignano

Eugenio Rignano was born on May 31, 1870, at Livorno in Italy His education was almost wholly physical and mathematical, and after graduating from the University of Pisa he obtained full engineering qualifications in 1893 Instead of practising this profession, however, he devoted himself to philosophical studies, being particularly interested in the borderline between philosophy and science, especially biology In later life he

was appointed professor of philosophy at the University of Pavia, although he had never officially taught that subject In 1906, Rignano was able to bring into being a scheme he had long cherished, namely, the foundation of an international journal dealing with the theoretical aspects of science and its relations with other realms of human experience Under the name of *Scientia* this journal continues to flourish, and Rignano edited it himself until his death on Feb 9 last Towards the end of his life he was the recipient of numerous honours, in 1920 he was the Michonis Lecturer at the Collège de France, in 1923 he was named corresponding member of the Institute of France, and in 1926 of the Academy of Madrid

Rignano's early association with engineering conferred a quality upon all his thought and writings which they never lost Instead of constructing bridges across material ravines, he was constantly eager to bridge the gulfs which separate opposing positions in philosophy, and in this process merely destructive criticism was useless to him Invested with a pre eminently cross bench mind, he approached each new opposition with only one prejudice, namely, that in all probability both sides would be partially right Although in many cases his diagnosis of where they were wrong did not commend itself to other students, the example which he gave of creative synthesis of antinomies always merited the utmost praise

In biology Rignano's efforts were all directed to mediating between the ancient enemies of vitalism and mechanism He recognised on one hand that mysterious postulates such as the entelechy were admissions of the bankruptcy of our notions of causation, but, on the other hand, he felt that teleological considerations were too closely bound up with the phenomena of life to come unstuck, as it were, from them, even through the powerfully solvent action of the study of scientific method Final causes were not, however, interpreted by Rignano in an Aristotelian manner, that is, as existing posterior in time to the events caused, his teleology was based on a postulated mnemonic quality on living organisms, which he called 'specific accumulation' With the aid of this hypothesis, and of one or two others, such as the attribution of a separate form of energy, equivalent to heat or mechanical energy, to living systems—a form which would be transmutable into any of the others, following the principles of conservation, and yet would not be measurable since no apparatus had been devised for measuring it—Rignano constructed a complete theoretical biology 'Energetical vitalism', as he called it, bridged the gulf between the disputants by retaining what was best from each, but it cannot be said to have won general approval, and is perhaps more valuable in its example than in its essence It is fully described in Rignano's "On the Transmissibility of Acquired Characters Hypothesis of a Centro-Epigenesis", "Biological Memory", "The Finalistic Aspect of Life", "What is Life?" and "Man Not a Machine"

In other fields Rignano's passion for synthesis and the abolition of contradictions appeared equally clearly In his "Problems of the Psyche", he attempted to conciliate English 'Associationism' on one hand and German 'Gestaltism' on the other, demonstrating that at least potential activity impregnates all the manifestations of thought In his "A Socialism in accordance with Liberal Economic Doctrine" he intervened between the elementary social justice to which the socialist critic appeals and the Utopian and impractical character of collectivism and other socialist systems, in order to advocate a gradual nationalisation of private capital by means of new laws relative to the right of testation Finally, in the domain of ethics, he faced seriously the conflict between the morals of paganism and of ascetic Christianity, and in his "The Purpose of Man" proposed an ethical system founded on the harmony of life His death is a severe blow to the constructive forces in philosophy at the present day

JOSEPH NEEDHAM

MR CHARLES EDGAR SALMON, the well known systematic botanist, whose sudden death occurred on Jan 1, 1930, was born on Nov 22, 1872 He was an architect by profession and had an extensive practice in the Reigate district Salmon was essentially a field botanist with a wide knowledge of the British spermatophytic flora, to the study of which he had devoted most of his leisure time for many years A considerable number of papers in the *Journal of Botany* and elsewhere testify to his industry and the part he played in advancing the study of British flowering plants In addition, Salmon was an authority on the sea lavenders (*Limonium*), and at the time of his death was correcting the proofs of a flora of his own county of Surrey He was an active member of the Linnean Society and served on its Council from 1920 to 1923 His extensive herbarium, including part of the collections of the late Mr Arthur Bennett, has been bequeathed to the British Museum (Natural History) His many colleagues will miss, first the help he was always willing to give in identifying species of the many genera with which he had worked and, above all, a genial unselfish friend remarkable for his amiability and sense of humour W B T

WE regret to announce the following deaths

Dr Henry J Cox, senior meteorologist in charge of the north central forecasting district and corn and wheat region service of the U S Weather Bureau, on Jan 7, aged sixty six years

Sir Gordon Guggisberg, K C M G, until recently governor and commander in chief of British Guiana, formerly surveyor general of Nigeria, and author, with the Rev. A G Fraser, of "The Future of the Negro", on April 21, aged sixty years

Dr R M Pearce, director of the Division of Medical Sciences of the Rockefeller Foundation, on Feb 16, aged fifty-five years

Mr P A Ralli, chief aerodynamic expert and technical engineer for many years of the Fairey Aviation Company, who was known for his studies of air screws, on April 17, aged forty-one years.

News and Views.

Prof Smithells, the retiring president of the Institute of Chemistry, discussed in his presidential address, which has recently been published, a matter which has become one of some concern to students, to teachers, and to employers, namely, the ever increasing load put upon professional chemical students The knowledge of inorganic, organic, and physical chemistry with which the student to day is expected to equip himself, usually within a period of three academic years, forms in its content of fact and charge on the memory a burden which Prof Smithells estimates to have nearly doubled during his own experience Whilst willing to admit that the capacity of succeeding generations expands, he does not believe that in such a brief period of human evolution the powers of apprehension or of memory have become doubled, he therefore anticipates that, as a result, there will be undigested knowledge of what are thought to be the higher things of chemical science, and, worse still, a superficial knowledge or entire ignorance of simpler things

Prof Smithells' own experience of the results derived from modern chemical curricula will find support in the experience of many of his professional colleagues both within and outside university chemical departments, and students themselves would be the first to admit that the width and depth of the studies now required of them in preparation for a first degree leave little opportunity for independent thought or for the free culture of the chemical arts Pressure similarly falls upon their instructors, who are too frequently condemned to spend their time term by term doling out partially predigested and ever growing masses of fact and theory in the hope that an adequate proportion will be retained long enough for examination purposes Specialist instruction properly finds its place in modern teaching institutions It is, of course, their function to disseminate what is erudite as well as what is simple and fundamental, to test all kinds of facts and theories, and to advance knowledge in every branch of learning Prof Smithells insists, however, that there is a limit to what may be rightly imported from new provinces into the common stock of what purports to be general chemical training In his experience a teacher reluctantly jettisons old cargo to make room for new, and since at the same time the last charge he would wish to lie against him is that of not keeping up with the times, the courses tend to become overloaded, the pace too great, and the foundation ill laid

Prof Smithells thinks that we have unwittingly allowed a good deal to come into our general courses of instruction that should be left for a subsequent period of specialisation In pleading for a slackening of the pace, he feels that we are sacrificing not so much any particular kind of knowledge as the conditions under which sound knowledge can be acquired He is, however, speaking of the training of professional chemists whose national responsibilities will in due time be so much greater than formerly, whose capacity will determine in no small measure the industrial future of their country Hence we would wish that Prof Smithells had laid greater emphasis on his statement that the young chemist is now often not kept long enough or exercised sufficiently in the wider territory of the science At least as long a road must be travelled whether the pace is moderated or not Students differ widely in their ability to assimilate what is presented to their minds and to their memories, but on the whole we feel that a case for such moderation has been made out If the sound fundamental training in the science, involving as it must do the basic principles of the most recent achievements as well as the older philosophy, cannot be acquired in three years, extension of the course for a first degree would be preferable to contraction of the field of vision

Nomenclature in chemistry is so devised as to reflect constitution and behaviour as concisely and as accurately as possible Among the more or less unsatisfactory names which chemists have inherited from an earlier age is the word 'chemist' itself, not that it does not describe concisely and accurately one who, in the definition employed by the "Encyclopædia Britannica", "for pleasure or profit concerns himself with the acquisition of information relating to the composition of bodies and the changes of composition which they undergo" The dissatisfaction arises from the fact that the law of England says that it means something quite different The use of the title by anyone who is not a registered pharmacist is, indeed, an offence, being prohibited generally by the Pharmacy Act, 1868 The prohibition is not, of course, enforced, but is for that matter none the more seemly None will deny that it is essential that the public should be protected, and proper that the profession of pharmacy should be closed to all but properly qualified persons—if need be by the grant of an exclusive title It is mentioned in a recent issue of the *Journal and Proceedings of the Institute of Chemistry* that representations were made on the subject to the Departmental Committee on the Poisons and Pharmacy Acts The Report of that Committee shows that the continuance of the anomaly is considered to be undesirable Pharmacists raise no objection to the use of the title 'chemist' by certain qualified, though unregistered, persons, except in connexion with a retail business The relinquishment of the title (in favour, for example, of 'pharmacist') by registered pharmacists was, however, considered to be impracticable from the point of view both of the expense involved in the alteration of signs and fascias, and of the popular connotation of the word itself

At his death in 1880, Frank Buckland left to the nation his Museum of Fish Culture, which is now at South Kensington, and a reversionary sum of £5000 with which to endow a professorship of economic fish culture The first fruits of this Buckland Foundation

were recently reaped when Prof W Garstang, of the University of Leeds, as Buckland professor for 1930, delivered the first course of fisheries lectures at Grimsby and Hull, an abstract of which appears elsewhere in this issue Remembering Prof Garstang's pioneer work in the transplantation of plaice from the nurseries off the coast of Europe to the rich feeding grounds of the Dogger Bank, it is singularly appropriate that he should have been chosen as the first to remind us of the life and work of Buckland, who early envisaged the 'farming' of the seas, just as the agriculturist farms the land One wonders what action Buckland would have advocated had he possessed the knowledge which has been acquired since his death and forms the subject matter of Prof Garstang's later lectures Would he have agreed with Prof Garstang that the solution of the plaice problem in the North Sea lies in transplanting every year some millions of the small, over crowded, and slow growing fish from the coastal banks to the Dogger? Furthermore, having agreed, would his great personal assets of earnestness and imperturbable humour, so helpful in negotiations, have enabled him to induce the traditional enterprise of the great Humber fishing ports to take up the matter of transplantation as a commercial proposition? Whatever the answers to these questions may be, the annual Buckland lectures will keep fresh the memory of a life devoted to the turning of natural history into practical channels, and will perform an additional service in indicating current progress towards the ideal of a rational exploitation of the resources of the sea

THOSE who, knowing the range of Prof P Debye's interests, and his remarkable linguistic powers, attended the Guthrie lecture of the Physical Society delivered by him on April 11 in the expectation of hearing original views delivered freshly and vigorously, were not disappointed Prof Debye has left his mark on modern science at many points, and it may be said of him with more truth than is to be found in most eulogiums, *nullum tetigit quod non ornavit* The debt of the chemist to him is a specially heavy one The theory of strong electrolytes was ever a difficulty until he took the matter in hand, and now his researches on X ray scattering promise equally to smooth the path of the organic chemist The scattering of X rays by the vapour of carbon tetrachloride and allied compounds formed the main part of Prof Debye's discourse An elementary investigation in which the effect of the carbon atom is neglected in comparison with that of the more massive chlorine atoms (considered as points) leads to an expectation of maxima of intensity in certain angular directions, which is confirmed by experiment A closer approximation may be made by taking into account the dimensions of the atoms, and the distance between the atoms calculated from observation of these maxima is in good accord with values obtained by independent methods More remarkable even, as illustrating the agreement between two quite independent arguments, are the results deduced from experiments made on *cis* and *trans* compounds Here the different distances between the chlorine atoms in the two forms as given by the structural formulæ of the organic chemist are faithfully reflected in the distances calculated from the results of Prof Debye's experiments If any one lesson may be drawn from his discourse, it is that the sciences cannot live in water tight compartments, and that organic chemistry in particular needs all the assistance that modern mathematics and physics can give The address, delivered in fluent and idiomatic English, was most happily balanced in its account of theory and experiment, and will live long in the memories of those who were privileged to attend it

AT the annual meeting of the East African Section of the London Chamber of Commerce on Mar 19, several matters of importance were dealt with A start has now been made with aerial surveys in East Africa, a subject to which the Section has devoted much attention during the last year or two, and it is probably largely through its efforts that the survey of Rhodesia has been decided on, for which purpose Mr Butler, chairman of the Aircraft Operating Co, left Heston on Mar 20 in a large Gloster biplane of new type for the aerial survey of 63,000 sq miles in Rhodesia It is hoped that other similar surveys will shortly be made in East Africa, for, as already pointed out in a memorandum which the Section submitted to the Council of the London Chamber of Commerce, such surveys are of the utmost value to a new and progressive country They are much more comprehensive and rapid than those on land, and are especially useful in connexion with the mapping out of routes for new roads and railways, of areas suitable for intensive development, forests, river courses, and much else The cost of these surveys could be looked upon as capital charge, and could doubtless be met from loans either under the East African Guaranteed Loan Act of 1926, or under the Colonial Development Act

ROAD and rail construction in British East Africa is likely to demand close attention in the near future The Council of the London Chamber has already adopted a recommendation from the Section that the Government should set up an Imperial Committee to study road transport in Central Africa (Rhodesia to the Sudan) and to make definite proposals for the construction and financing of a satisfactory road and bridge system The Prime Minister promised to give the matter earnest consideration, and it was further considered at a special meeting last October when various technical experts were present It is suggested that the vast areas in East Africa can only be opened up adequately by a carefully designed road system as an adjunct to the railway system, and so far little attention has been given to roads especially in Kenya and Tanganyika There have been several complaints as to the roads in Kenya of late, and the recent floods in Tanganyika have of course played havoc with the road system in that country According to the *East African Standard*, Mr G H Moore, Director of Roads, etc, in Kenya, and also other authorities, are giving the matter very close attention, and the possibility of a loan for a large programme of road construction is under discussion

At the general meeting of the Rubber Growers' Association (Inc) on April 11, the chairman, Mr G H Masefield, gave the following figures regarding the use of rubber in recent years The absorption of crude rubber during 1920 was 310,000 tons, of which the United States used 215,000 tons and the rest of the world 95,000 tons By 1925, these three totals were 435,000, 315,000, and 120,000 tons respectively, while by 1929 the corresponding figures were 785,000, 470,000, and 315,000 tons During the last nine years, he said, the world consumption has increased by 153 per cent, the consumption of the United States by 119 per cent, and that of other countries by 232 per cent The Association, the constituent companies of which control 1,812,000 acres planted or interplanted with rubber, takes an active part in the work of scientific research in Malaya, Ceylon, South India, and in the Netherland East Indies, and, said Mr Masefield, "There can be no question that research work will become an increasingly important factor in the future, and it will be to the scientists that we must look if we are to avoid and combat the dangers that are likely to threaten the industry when we face on the one hand huge areas of plantations run on scientific lines, and on the other an almost equal area of rubber planted haphazard in small holdings on which disease in many cases is likely to become completely out of hand"

It is announced that the Second International Congress of the History of Science and Technology is to be held in London in July 1931 These congresses take place biennially and are organised by Le Comité International d'Histoire des Sciences, which was founded at Oslo on Aug 17, 1928, and the permanent secretary of which is Prof Aldo Mieli The aim of the Congress is to provide opportunity for intercourse and exchange of thought between all those who are interested in any aspect of the history of science and technology The co operation of the three international societies which cover this field of learning, namely, the History of Science Society, the Newcomen Society for the Study of the History of Engineering and Technology, and Le Comité International des Sciences Historiques, has already been assured A number of influential men of science are giving their support, and a council is now being formed to further the aims of the Congress A programme is being arranged to cover a period of five days, during which scientific communications will be received, visits to places of historic interest will be made, and social gatherings will be held The headquarters of the Congress is at the Science Museum, South Kensington, S W 7, the honorary secretary is Mr H W Dickinson, from whom further particulars can be obtained

The establishment, on the recommendation of the U S National Academy of Sciences, of the new Woods Hole Oceanographical Institution is of much interest and importance Its purpose is to carry on and encourage the study of the sea in the broadest sense, and funds from the Rockefeller Foundation are available for the building and for a sufficient operating income It is, like the Marine Biological Laboratory at Plymouth in Great Britain, an independent organisation, but similarly assured of informal association with other educational and research institutions through its trustees The initial board includes many well known names, with Dr Henry R Bigelow as director and Dr Frank Lillie as president After careful consideration, Woods Hole was chosen as the site of the new Institution, the principal reasons being its proximity to the famous marine biological laboratories and its extremely favourable position with regard to the neighbouring waters Some of the most productive fisheries can be reached in a few hours, and the variety of conditions is unparalleled It is planned to have a sea-going ship equipped for scientific investigations in all fields of oceanography, capable of extended voyages, to be in commission throughout the year, and to have a resident staff for the laboratory Plans are already in preparation, and it is hoped that the Institution will be ready to open by the summer of 1931 Meanwhile, the trustees will announce the plans for research based on the general principle of offering opportunities to visitors from America or from other countries, especially for work at sea, and for them to co-operate with the staff in a general programme of oceanographical research, besides giving every facility to individual workers on shore It is hoped also to offer instruction to university students in oceanographical methods both at sea and in the laboratory. This institution will be a welcome addition to the resources of oceanographical studies

The gorilla expedition, organised under the joint auspices of the Carnegie Institution of Washington and Yale University, which set out last June for Central Africa, has completed its work, and a summary of results has been issued by the Carnegie Institution Dr. Harold C Bingham and his wife reached the Belgian gorilla reservation in the Kivu region early in August and commenced work at the spot where Carl Akeley died in 1926 They were frequently in contact with various gorilla groups, following them as they fed their way along, carefully recording, for future study, observations on the nests, the feeding habits, the social responses, the nomadic behaviour, and the individual traits of the animals They took moving and still pictures whenever conditions favoured The mountain gorilla of this region inhabits the slopes of volcanic peaks at an altitude of 8000 to 12,000 ft, and it is especially in the bamboo belt of the dense forest and for a considerable distance above it, that the gorilla ranges in search of food This consists mainly of the succulent 'suckers' sent up by the bamboo roots, and of a luxuriant 'wild celery' which attains a height of six to eight feet over extensive areas

Doubt has been expressed regarding the nesting habits of the mountain gorilla, some reports stating that nests are constructed in trees, while others allege that they are never built off the ground Dr and Mrs Bingham undoubtedly found, in and below the bamboo belt, that tree nests were built, sometimes as high as fifty feet above ground, and they also found old nests of chimpanzees The gorilla nests were very simple

affairs, usually made by pulling and breaking down the plants and vines which chanced to be at hand They gave evidence of being occupied only for a single night during the perpetual wanderings of the gorilla bands But the explorers are cautious about dogmatising concerning the position of the nests, and suggest that the varying physical conditions in the areas over which the gorillas range may lead to important differences in feeding and nesting habits They think it probable that changes in climate, in seasons, in rainfall, in temperature, possibly also changes in air currents and the like, may affect the behaviour of the gorillas so that they exhibit significant environmental adaptations

RUGBY School Natural History Society, as the *Report* for 1929 shows, has greatly increased its adherents by the introduction of popular lectures and exhibits of kinematograph films On the other hand, the attendances at the specialised sections has fallen off and many of the reports of the secretaries show a very great lack of interest on the part of members in lectures and even open air excursions The contrast suggests that it may be mistaken policy to form highly specialised sections (there are twelve in the school) the efforts of which must appeal strongly to very few boys Boys will have hobbies, and hobbies are to be encouraged but the place of a school natural history society is not to intensify the notion of specialism and sectionalism, but to keep in the forefront the idea of scientific unity, and to encourage at the school stage the widest possible acquaintance with the various aspects of scientific truth

COMPARISONS may be instructive, and the Report of the Marlborough College Natural History Society for 1929 has just been received The Natural History Society here has also its sections, but there are five only, and the enthusiasm of the members is evident Not only have the sections been well supplied with lectures, but the original records and observations in the ornithological, entomological, and botanical groups cover many pages More than half the Report (of 120 pages) contains excellent articles dealing mainly with local matters of scientific interest and including a list of the microlepidoptera of the district compiled from the Society's records, a good list of 677 species From the miscellaneous notes we learn that the grey squirrel has made its appearance in the neighbourhood

IN the course of a Lucknow University Extension lecture on Nov 15, 1929, on the interpretation of the Raman effect, a copy of which has reached us, Mr Satyendra Ray put forward a novel point of view He looks on the Raman lines as related to an effect which he calls the Bhar effect—namely, that the position of a line in a spectrogram depends upon the intensity of the source, which is taken to prove that the velocity of light is not constant, but depends upon the amplitude, analogously with sound In experiments on this effect made in 1925 by Mr Ray using rhodamine solution to weaken the *D* lines by absorption and so vary the effective amplitude of the source, the *D* lines shifted different amounts for different concentrations of the rhodamine solution, and for certain critical densities gave rise to a continuous band This is taken to be connected with the Raman effect, and particular attention is directed to the continuous spectrum often found in Raman spectra Mr Ray believes that a classical dynamical interpretation of the Raman effect can be made if it is recognised that the velocity of light is variable, that transformations of frequency are possible, and that combination tones are possible, whether differential or summational

THE Ordnance Survey has tried the experiment of issuing certain sheets of the maps of Great Britain on a tough waterproof paper This paper is not merely coated with a waterproof solution but is also impregnated after printing by a process which, it is claimed, renders it absolutely waterproof and washable, and gives it a parchment like appearance These claims appear to be justified The paper is unaffected by water and after crumpling can be ironed flat Efforts to injure our review copy by any usage to which a map might probably be subjected in the field, failed to make any notable impression The colour and legibility of the map are fully as good as the usual sheets The map is not thicker than the paper edition mounted on linen Undoubtedly this innovation should prove a blessing to those who need to use maps in the open in all weathers The sheets at present available are the "Tourist" 1 inch sheet of the Middle Thames, several of the "Popular" 1 in sheets, including some in the Midlands, Surrey, Kent, and Perthshire, and sheet No 8 of the quarter inch map of England and Wales The prices are those of the ordinary edition linen mounted and cut into sections

AN announcement of the highest importance to museums in Great Britain is made in the April number of the *Museums Journal* The Trustees of the Carnegie United Kingdom Trust have already shown in the Report issued under their auspices their interest in the progress of the museum movement As a sequel to that Report they have now announced a practical move to test its conclusions This limited preliminary experiment is to be carried out in collaboration with the Museums Association, is to cover the five years 1931–35, and is to involve an expenditure of £10,000 The money is to be allocated under a threefold scheme In the first place, £7000 is to be devoted, in grants of not more than £250 each, to public museum authorities who are prepared to adopt some definite policy and to reorganise their institutions on the lines recommended by Sir Henry Miers in his 1928 Report to the Trustees The grants are to be confined to towns with between 10,000 and 70,000 inhabitants, may be used for capital expenditure only, will not be available for building purposes, and will probably be offered on a £ for £ basis

A FURTHER move on the part of the Trustees of the Carnegie United Kingdom Trust is the offer of £3000 for the training of curators, but since the Museums Association is already negotiating with the national museums in London for an experimental school there, the Trustees will take no action until the result of this experiment has been considered In the third place, the Trustees, after their experience in connexion with the co-operative library service in rural areas, believe that some similar scheme might be the subject of a

useful experiment in the sphere of museums They therefore propose, with the collaboration of the Museums Association, to explore this possibility This broadly conceived experiment opens up wide prospects of benefit to the public through the agency of museums, and we wish it every success

Prof Niels Bohr, of Copenhagen, will deliver the Faraday Lecture of the Chemical Society on May 8, taking as his subject "Chemistry and the Quantum Theory" The lecture will be delivered at the Salters' Hall, St Swithin's Lane, E C 4

The Faraday Medal of the Institution of Electrical Engineers will be presented to Sir Ernest Rutherford at the ordinary meeting of the Institution to be held on Thursday, May 1 The presentation will precede the twenty first Kelvin Lecture, which will be delivered by Mr R H Fowler on "Some Recent Advances in the Electron Theory of Metals"

The following appointments have been made at the Museum of Science and Industry, Chicago Dr Louis Ehrenfeld, of North western University, to be curator of organic and industrial chemistry, Mr Herman R Eberle, of the Michigan College of Mining and Technology, to be assistant curator of mining, Mr M K Hubbard, of the University of Chicago, to be research associate in geology and geophysics

Sir William Bragg, Fullerian professor of chemistry in the Royal Institution and director of the Davy Faraday Research Laboratory, who has been awarded the Franklin Medal for his work on X rays and crystal structure (Nature, Feb 22, p 286), will visit the United States shortly, when he will receive the Medal in the hall of the Franklin Institute, Philadelphia, on May 21 and deliver an address Sir William will also give lectures at Johns Hopkins University, Baltimore, at Columbia University, New York, and at Princeton University

Prof M Siegbahn, of the Physical Institution, Uppsala, referring to the article on the Nobel Foundation in Nature of Mar 29, writes to say that when Dr Nobel was asked to send to the University of Uppsala some biographical details in connexion with the conferment upon him of the honorary degree of doctor of philosophy, he stated that he was a member of the Royal *Institution of London*, and no mention was made of the Royal *Society* The quotation given in Nature was from Nobel's "Life", which was translated from the German work We suggest that though Nobel wrote *Institution* in his note, this was inadvertently understood as *Society* when rendered into German or in the English translation where the word wrongly appears

The following medal awards for 1929 and 1930 have been made by the American Geographical Society *Cullum Geographical Medal* for 1929 Dr Hugh Robert Mill, formerly director of the British Rainfall Organization, Prof Jean Brunhes, professor of human geography at the Collège de France, and author of "La géographie humaine", and related works, Prof Alfred Hettner, professor of geography in the University of Heidelberg, and founder and editor of the *Geographische Zeitschrift*, and Prof Jules de Schokalsky, professor of oceanography in the Leningrad State University, and president of the Russian Geographical Society Awards of the Cullum Geographical Medal, given from time to time to those "who distinguish themselves by geographical discoveries, or in the advancement of geographical science", had not been made since 1925 *Charles P Daly Gold Medal* for 1929 Cav Filippo De Filippi, secretary general of the International Geographical Union, who has done distinguished work in exploration, and Prof Émile Félix Gautier, of the University of Algiers The Charles P Daly Gold Medal is awarded from time to time "for valuable or distinguished geographical services or labours" The last award was made in 1927

Fowl typhoid, an acute infectious disease of fowls, is the subject of a leaflet (No 39) issued by the Ministry of Agriculture and Fisheries The symptoms, diagnosis, and spread of infection are described, and directions are given for eradication and prevention

The *Journal of the Cancer Research Committee of the University of Sydney* for February (vol 1, No 4) contains an article by W B S Bishop on the occurrence and possible importance of the metallic elements in animal and plant tissues A very useful summary of the subject is given, with a list of 143 references to the literature

A second edition of "A Summary of Facts regarding Malaria", by Sir Ronald Ross and Sir Malcolm Watson, has been issued (John Murray, Albemarle Street, W, 6*d*) This pamphlet gives an excellent popular account of malaria, and the parasites and the fever, the mode of infection, and some facts concerning mosquitoes are briefly described The final pages deal with prevention, personal and public, of the disease

The March issue of the *Bulletin of Hygiene* contains a review by Dr J D Rolleston of recent literature on the tobacco problem, including the historical aspects and prevalence of the tobacco habit, experimental work in connexion with nicotine and other constituents of tobacco smoke, the nicotine content of cigars and cigarettes, with special reference to so called 'denicotinised' tobacco products, the relation of tobacco to public health, and the pathological effects of tobacco, especially on the alimentary, cardio vascular, and nervous systems

Applications are invited for the following appointments, on or before the dates mentioned —A geologist in the Geological Survey Office, Department of Industry and Commerce, Irish Free State—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin, C 8 (April 30) A full time assistant teacher in the Engineering Department and Junior Technical School of the Harris Institute, Preston—Principal and Secretary, Harris Institute, Preston (May 2) An assistant clinical pathologist at the General Hospital, Birmingham—The House Governor, General Hospital, Birmingham (May 6)

A head of the Department of Mechanical Engineering, an assistant master in botany and chemistry, an assistant master in electrical engineering, and a teacher of workshop practice (electrical and motor engineering) at the Liverpool Central Municipal Technical School—The Director of Education, Education Offices, 14 Sir Thomas Street, Liverpool (May 7) An assistant in electrical engineering at the Rutherford Technical College, Newcastle upon Tyne—The Director of Education, Northumberland Road, Newcastle upon Tyne (May 17) A full time graduate assistant in the Department of Engineering of the Leicester College of Technology—The Registrar, College of Technology, Leicester (May 18) An assistant professor of chemistry in the University of Manitoba—The Secretary to the Board of Governors, University of Manitoba, Winnipeg, Canada (June 1) A professor of physiology at Middlesex Hospital Medical School—The Academic Registrar, University of London, South Kensington, S W 7 (June 12) A development officer and a research manager under the British Non Ferrous Metals Research Association — The Director, British Non-Ferrous Metals Research Association, 71 Temple Row, Birmingham A junior assistant under the Directorate of Explosives Research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S E 18

Our Astronomical Column.

The Lowell Object —A very remarkable orbit of this object has been computed by the Flagstaff astronomers, and distributed by telegram from Prof Shapley (*I A U Circular*, No 271) They find an ellipse with eccentricity, 0 909, semi major axis, 217 units, perihelion distance, 19 64 units, perihelion passage, 1900 5, longitude of perihelion, 12° 52′, ascending node, 109° 21′, inclination, 17° 21′ mean daily motion, 1 112″, period, 3191 years, present distance from sun, 41 3 units There is no doubt that the present distance and the node and inclination are near the truth, but the eccentricity is stated to be uncertain If the above value is right, the object would have been of the twelfth magnitude when in perihelion, so that there ought to be little difficulty in finding images of it on old plates It is advisable to make search in the first place on fairly recent plates, as the limits of error are much smaller, the following short ephemerides have been prepared from these elements, they are for 0 h

1928		R A	N Decl	1929		R A	N Decl
Jan	1	7h 9m 11s	21° 23	Jan	1	7h 15m 8s	21° 39
,,	17	7 7 40	21 27		17	7 13 40	21 42
Feb	2	7 6 15	21 30	Feb	2	7 12 16	21 46

The uncertainty of these positions is much smaller than that of the elements, and should not exceed a few minutes of arc All the observatories that search for minor planets are likely to have plates of the region Rough ephemerides for earlier years can be formed from the annual differences shown above

Periodic Changes in the Solar Corona — The connexion between the form of the corona and the phase of the sun's general activity in the 11 year period has long been known, with the natural result of a similar (though less marked) relation with the sun's spotted area Dr W J S Lockyer pointed out in 1903 that prominences were related much more closely than spots to the coronal form, and fully confirmed this result by a further research in 1922 in which the material was brought up to date In a recent paper (*Upsala Meddelanden*, No 46) Prof Bergstrand reaches the same conclusion by an analysis of previously published results of Ludendorff, in which the latter gives 'isophotes' (lines of equal luminosity in the corona) for different eclipses Bergstrand gives a correction to these isophotes in the polar regions to allow for the superposition of streamers from equatorial or intermediate latitudes, and deduces a quantity, p, giving the ratio of coronal luminosity in equatorial and polar regions at the same height above the solar surface There is a slight correlation between p and sunspot numbers, but the variations in the former follow much more closely those of prominences in the high latitude zone Prof Bergstrand is led to the "irresistible impression that the strong development of the polar corona towards the epoch of sunspot maximum is related to the simultaneous appearance of prominences in the neighbourhood of the solar poles", thus strongly supporting the work of Lockyer mentioned above

Radial Velocities of 741 Stars —A valuable addition to our knowledge of stellar radial velocities appears in the *Astrophysical Journal*, vol 70, p 207, in which results are given for 741 stars measured at the Mount Wilson Observatory by Messrs Adams, Joy, Sanford, and Strömberg The 60 inch and 100 inch reflectors were used, with one prism spectrographs giving dispersions ranging from 37 A to 76 A per mm in the neighbourhood of $H\gamma$ The majority of the stars are of spectral types F to M, but some (91) of types O, B, and A are also included Their visual magnitudes range from 3 0 to 10 8, most of the fainter stars being dwarfs with large proper motions which show (as might be expected) a considerable proportion of large radial velocities An interesting feature of the results is the almost complete absence of large positive velocities from R A 15h to 2h in the northern hemisphere, thus illustrating the asymmetry of stellar motions previously noted by Stromberg This list brings the number of radial velocities determined by the two large Mount Wilson reflectors up to a total of 1754

Handbook of Cracow Observatory for 1930 —This is the eighth issue of this useful annual handbook, which is edited by Prof Banachiewicz The greater part of it is occupied with ephemerides of variable stars, both long period and eclipsing Then follow tables of obliquity of ecliptic, precession, selenographical co ordinates, and predictions for 1930 of occultations of stars by the moon, for five observatories in Poland It is suggested that the selenographical co ordinates may be used to find the regions of the moon at which occultations occur, and then apply corrections for the altitudes of these regions This is a refinement that will doubtless become general in the future, there is not the same need for it in meridian observations of the moon, as a long arc of the limb is visible, and the eye can make an estimate of the mean position of the limb, which is certainly more accurate than observing an outlying mountain But in all the most accurate observations of occultations the limb is dark, and these irregularities are invisible The headings and explanations of the tables (except those relating to the details of occultations in Poland) are given both in Polish and in flexible Latin, the latter being easy to read

Research Items

Australian Petroglyphs—The discovery of a number of petroglyphs, believed to be new, by Mr B E Hornshaw is recorded in the *Victorian Naturalist* for February Mr Hornshaw has spent some twenty years searching for art relics of the aborigines and has found many examples previously unknown Those which he now describes are situated in Kuring gai Chase, between Cowan Creek and Pittwater, about 35 miles from Sydney Among them—all being engraved with the exception of a number of hands stencilled in red in a rock shelter—was a large carving deeply cut and about 9 ft in height, such as the author had not seen before in all his twenty years' experience The upper part of the figure is shaped like the head and bill of a platypus The arms are outstretched, showing a large boomerang in one hand, while the other points to a female The conjecture is made that it represents the totem deity of the Kuring tribe The female figure has her arms upstretched, with a circle attached to the left leg It is suggested that the site may have been used as a bora ground for the initiation of young men into the tribe

Egyptian Chronology—In *Ancient Egypt*, 1929, pt 2, Sir Flinders Petrie reopens the discussion of Egyptian chronology in the light of fresh evidence obtained from last season's excavations in Palestine at Beth pelet A long series of scarabs has been found which belongs to a large part—nearly the whole—of the Hyksos period From these it is now possible to deal with this age on a monumental basis Provisionally, the groups of scarabs have been classified in a succession of styles lettered from *A* to *W* In *A* and *B* the resemblance to good Egyptian work is very close, soon follow, in *C* and *D* figures, decomposed signs and the late Hyksos type of a name between vertical lines, and so forth to a final stage showing twists and side lines derived from decomposed *neter* signs Amid these changes down to the middle of the series are often various types which can be dated to known kings So close is the comparison that it is hard to believe that these types, decaying in the thirteenth Dynasty, were revived at a later date Indeed, the twelfth and thirteenth fashions had been so closely followed in the different types, that it is impossible to regard the Hyksos forms as belonging to a much later series This constitutes a strong case for the Hyksos age being contemporary with these two dynasties Turning to the literary record, if the lists of Manetho be used, it must be by placing the fifteenth and sixteenth Dynasties side by side with the thirteenth and fourteenth, Salatis, the first of the six great kings, probably entered the Delta at about the close of the reign of Amenemhat IV The Hyksos may have gradually occupied the Delta from the thirteenth to the fifteenth Dynasties and the whole of it up to Memphis by about the time of the twenty first king The recorded periods would then adjust themselves to show the thirteenth Dynasty ending in 1922 and the fourteenth at 1738, the seventeenth extending from 1738 to 1587

British Bird Ringing—The *British Birds* marking scheme has been by far the most thorough of British ringing agencies, and with the conclusion of 1929, when the record was reached with 25,243 individuals marked, a grand total of 258,791 has been accounted for during the twenty one years of the scheme In his summary of the year's work, H F Witherby mentions some interesting records—a ring ouzel ringed in Dumfriesshire recovered in Algeria, a Cumberland teal in the Gulf of Archangel, a Kinross wigeon two years later near Novgorod, Russia, and so on (*British Birds*, March, p 258, 1930) On the whole, the striking feature of the list with which he concludes his paper is the very small number of recoveries of ringed birds Most exceptionally, as in the case of the merlin, as many as 20 per cent have been seen again, but the general run of recoveries is 2 4 per cent and often the recoveries are negligible The low recoveries often affect unlooked for species Of 413 grey wagtails ringed between 1909 and 1928 only one has been recovered, and only one wood warbler out of 813 ringed, one sedge warbler out of 647, and not a single garden warbler out of 660 Of the common wren 2856 have been ringed in the same period and only 8 have turned up again The figures suggest that now certain birds might well be struck off the list, since they are unlikely to yield scientific data of value and they themselves cannot come scatheless out of the process

Chinese Amphibia—A useful check list of Chinese amphibia with notes on geographical distribution has been compiled by N Gist Gee and Alice M Boring (*Bull Pekin Soc Nat Hist*, vol 4, pt 2, p 15, December 1929) The list records 131 species, including one Apoda, 15 Caudata, and 115 Salientia An analysis of the ranges of the species shows that the amphibian fauna may be divided into a north China group with palæarctic affinities and a south China group with Indo Malaysian affinities Although there are only four genera peculiar to China, there are 84 endemic species, 53 being localised in mountain ranges, 13 on islands, and 12 in the northern mainland section There seem to be three mountain centres of species formation Szechuan, Yunnan and Fukien, and the situation of these areas means that most of the endemic species are in the south central region Both because of this and because the Indo Malaysian amphibian fauna is richer than the palæarctic, the amphibian fauna of south China is much more abundant than that of north China, but the wide range of the species in the latter area suggests that many problems of specific and subspecific forms may still have to be dealt with there

Value of Field Studies in Zoology—Dr S L Hora chose as the topic for his presidential address to the Section of Zoology of the Seventeenth Indian Science Congress at Allahabad in 1930, "The Value of Field Observations in the Study of Organic Evolution" (Calcutta, Asiatic Society of Bengal, 1930) This is a subject at which the author has worked for a number of years and to which he has obviously given much thought The aspect of field work chosen to illustrate the address is the structural modifications undergone by the fauna of torrential streams to meet the strenuous demands of the environment, and in particular those exhibited by the fishes The genus *Nemachilus* provides interesting parallel series of modifications of the 'air bladder' in correlation with diverse habitat preferences in swift streams and still lakes in different river systems The author puts forward a well timed plea against the enthusiasm of those who advocate experimental zoology as the solution of all problems, and claims with Kerr that "evolution is a philosophy of wild Nature"

New Species of *Amœba* with a Stigma—A Pascher (*Biol Zentralbl*, Bd 50, Heft 1, 1930) describes *Amœba stigmatica*, a relatively small species 0 03 to 0 05 mm in diameter, with two contractile vacuoles, zoochlorellæ and a large, grooved, bright red stigma The nucleus has a granular karyosome of moderate size No flagellate stage was seen, nor was division of the active amœba or holozoic feeding observed The reserves in the cytoplasm are fat and oil droplets

Encysted examples had a firm, light yellow envelope surrounding the contracted protoplast, the zoo chlorellæ and the stigma From one cyst issued a single amœba, but in another, division occurred and two amœbæ issued This amœba is markedly photo tactic probably due to the presence of the stigma, but the symbiotic algæ may also be a factor This amœba is to be regarded as a descendant of a chromatophore bearing flagellate The grooved type of stigma is found in only two groups of flagellates, the Euglenidæ and the Dinoflagellates, and the author considers the former the more probable line of origin This new amœba affords further evidence in support of the origin of the Rhizopoda from the Flagellata

Marine Mollusca off the West Coast of Ireland —The Fisheries Branch of the Irish Department of Agriculture has done much dredging off the west coast of Ireland since 1900, and an account by Anne L Massy of the mollusca procured—exclusive of the Cephalopoda Amphineura Nudibranchia Pteropoda and Heteropoda—has now been published (*Proc R Irish Acad*, vol 3, Sect B, No 13) The area dealt with lies between 49° N lat and 56° N lat, and between the 50 fathom and 1500 fathom lines, exclusive of the area to the east of the Fastnet Light Since the *Porcupine* expedition of 1869, dredging has taken place from time to time in different parts of the area, and to make the present paper more complete all records from these earlier researches have been included In all, 313 species are enumerated, mainly under the nomenclature of the Conchological Society's 'List' of 1929 Under each species are given the occurrences at fisheries branch stations, previous records distribution in space, vertical range, and fossil records, whilst a bibliographical list of references particulars of stations, and index of genera conclude the paper, which thus forms a most valuable contribution to a knowledge of the molluscan fauna of the seas off the British Isles

Transplanting Cereals —For several years past extravagant claims have been made of large increases in yield resulting from the transplantation of cereals *Landtechnik* (quoted in *Jour Min Agric*, March 1930) gives the results of records of German experiments obtained by the Reichskuratorium fur Technik in der Landwirtschaft In 146 experiments observed in 1929, the spacing varied from 20 cm × 20 cm to 35 cm × 35 cm, tillering in all cases being extraordinarily good The transplanted plots were 8 14 days later in ripening than those drilled in the usual way, and as the former also suffered from the dry period of the year, the yields may have been unfavourably affected thereby Only 32 4 per cent of the transplanted plots gave higher yields than the drilled plots, whereas 67 6 per cent showed lower yields The yield increases were between 0 and 69 2 per cent, less than half of the increases being greater than 30 per cent In no single instance was 100 per cent increase recorded It is considered that the value of the transplanting of cereals must be regarded as negative from the point of view of practical agriculture Nevertheless, in view of the fact that increases of about 50 per cent were obtained in certain properly controlled experiments, it is desirable that the investigations should be continued in order to determine the conditions of growth under which these yield increases occur, and this work is being carried on by the Landwirtschaftliche Hochschule, Berlin

Rainfalls Accompanying Volcanic Explosions —In the literature on volcanic explosions, there are numerous references to mud flows, and landslides that have their cause in heavy rainfalls, the alleged source of which is in condensed steam In the *Am Jour Sci* for February 1930, R H Finch examines critically the evidence bearing on the source of such rainfalls, the records of the 1924 explosion of Kilauea supplying most of the data for the discussion Rain falls do not accompany all volcanic explosions and the heaviest rains reported at Mt Pelée and Vesuvius did not immediately follow the maximum of activity On the other hand, the available records show good correlation between observed relative humidity and rainfall It is concluded that while light rains may well have had part of their source in condensed steam the main source must be the moisture of the surrounding air

Recent Spectroscopic Researches - The issue of the *Zeitschrift fur Physik* for Feb 10 (vol 60, Nos 1 and 2), which is devoted to publications from the University of Bonn, contains a number of important papers dealing with several branches of spectroscopy Extreme infra red work is represented by contributions from E Rutten and T Dreisch on absorption by thin sheets of metal and other substances P Lueg gives an account of improved methods for photography in the near infra red and he and Miss J Querbach describe some spectra obtained in part with the aid of the new technique Contributions to the measurement of standards of wave lengths are made by P H Brodersen and H Pressentin Other papers are by Prof Mecke and R M Badger, on the atmospheric absorption band of oxygen at 7600 A, by W Scheib, on the band spectrum of boron monoxide, which has been measured and analysed, and by W Kerris, on the spark spectrum of iodine The whole forms a notable addition to the literature of spectroscopy, and has evidently been largely inspired by Prof Konen and Prof Mecke

Tests of Tool Steels —In order to provide information as to the behaviour of tool steels when used as in average workshop practice an extensive series of tests has been carried out at the U S Bureau of Standards at Washington by Messrs H J French and T G Digges, who give an account of their results in the first 70 pages of the December issue of the Bureau's *Journal of Research* Their method consists in setting two tools at equal depths in the same tool holder and noting when the following tool begins to cut on account of the wear of the leader, and they investigate the effects of tool form, depth of cut, feed, cutting speed lubrication, composition of the steel and its heat treatment on the life of the tool They find that the life is inversely proportional to the tenth or twelfth power of the cutting speed, is not much influenced by the lubricant while of twelve elements added to chromium tungsten vanadium steel, only one, nickel, produced decidedly beneficial results on the life, copper had a slight, tin a greater, and arsenic and antimony decided, adverse effect

Automatic Thermostat —An automatic temperature control apparatus for experimental chambers heated by alternating electric currents, which claims to regulate to 1/100° C, has been introduced by Messrs Baily, Grundy, and Barrett of Cambridge A thermometer in the chamber has an adjustable platinum wire above the mercury with which the mercury on rising makes contact and so applies to the grid of a valve a suitable potential The anode current produced operates the main contact in the heating circuit, which may take a current of 10 amperes The filament, grid, and anode potentials are supplied by a small transformer on the alternating mains, and the power used is about 0 6 unit per day

Electrical Applications in Motor-Cars —In the *Journal of the Institution of Electrical Engineers* for

January, an interesting account is given by Prof Parker Smith of the progressive development of electrical applications to motor cars In the early days, any electrical accessories were added after purchase At the present time, they form an integral part of the equipment and are built into the chassis by the manufacturer Electric ignition, which is now universally adopted, was the earliest application Electric lighting also has gradually displaced the one time popular and originally more powerful acetylene lamp Batteries being introduced, a charging dynamo became a necessity This was followed by the starting motor now almost universally used on private cars and widely adopted on commercial vehicles The later introduction of other electrical devices such as electric horns, windscreen wipers, fuel pumps, and signalling devices was both simple and natural The author points out that, almost without exception, every piece of electric equipment for automobiles had to be developed against strong competition from non electrical alternatives The stage of development seems now to be passing, and signs of standardisation, with the consequent cheapening of the products, are making their appearance British manufacturers, backed by the British Engineering Standards Association, are making determined attempts to ensure interchangeability of parts wherever possible Since the beginning of the War, the modern magneto has been immensely improved and dual ignition is generally regarded as unnecessary Perhaps the question of 'glare' is the problem that has not yet been satisfactorily solved

Rauschelbach Current Meter—Particulars have reached us of a new electric current meter (Dr Rauschelbach's design) manufactured by the Askania Werke A G of Berlin Friedenau, which is intended for use in determining the direction and velocity of tidal, coastal, and marine currents by means of observations from a vessel riding at anchor It is claimed that accuracy of direction can be obtained within limits of 3° and velocities within a range of 0 05 to 3 mm The appliance consists of a frame with suspension cables, supporting the meter with its switchgear, spindle, current vane, propeller, contact box, loading weights, etc The meter is secured within the frame and rotates freely on the vertical spindle, to which are attached a multi bladed propeller and a controlling vane of the usual type The revolutions of the propeller are transmitted by worm gear to a contact disc in the contact box, and thence to the recording instrument which is kept on board The recorder is provided with fourteen pens, having fourteen corresponding electro magnets to actuate them each time the respective circuits are closed The first of these pens traces a time record on the chart, the second records the number of revolutions of the propeller, and the remaining twelve serve to show the direction of the current Testimony is adduced from the Königsberg Water Board to the effect that the meter has been satisfactorily employed for a year in the harbour of Pillau and adjacent waters Several instruments are also stated to have been in service during the summer of 1928 on the lower Elbe and outer Ems

Odoration of Town Gas—The possibility of making illuminating gas more powerfully odorous with the object of preventing poisoning through leakage is attracting attention, and a pamphlet on the subject has been published as No 6 of the *Abhandlungen aus dem Gesamtgebiete der Hygiene*, edited by Dr R Grassberger of the University of Vienna A large number of experiments made with various substances of sufficient volatility and powerfully odorous showed that the liquid hydrocarbons separating from compressed oil gas and the light oil pre-distillates of gas works were most suitable So long as it is impossible to transform the carbon monoxide of the gas into methane, it is suggested that the gas should be impregnated with the vapours of these materials

The Glass Electrode—The use of the glass electrode in potentiometric measurements is extending, and in this connexion the existence of a permanent potential difference across the glass film is of importance This disturbing effect has been investigated by MacInnes and Dole, who have studied its relation to the composition of the glass The January number of the *Journal of the American Chemical Society* contains a paper by these authors in which previous work is briefly mentioned and in which further experiments are described The most suitable type of commercial glass was found to have the composition SiO_2 72, Na_2O 22, and CaO 6 The potential at the surface of this glass changed quantitatively with the hydrogen ion activity up to *p*H values of 9 5, though this limit was lowered in strong salt solutions, Since the glass electrode is used in biological work, it is essential that these anomalies should be known

Molecular Weight of Casein—In view of the discordant results given for the molecular weight of casein, a new determination by Svedberg, L M Carpenter, and D C Carpenter by the ultra centrifuge method, and described in the January number of the *Journal of the American Chemical Society*, is of considerable importance Casein prepared by the Hammarsten method was found, in *p*H 6 8 buffer solution, to consist of a mixture of protein molecules of different weight An alcohol soluble casein was prepared from Hammarsten casein and was found to be homogeneous and probably a pure chemical individual The molecular weight was 375,000 ± 11,000 The molecule was not spherical and deviated from the spherical shape by about the same amount as found for several other proteins The same journal also contains a paper by Svedberg and Sjögren on the molecular weights of two vegetable proteins, amandin and excelsin, determined by the centrifuge method These were found to be 208,000 ± 5000 and 212,000 + 5000 at various *p*H values Both molecules are spherical with radii of 3 94 mμ and 3 96 mμ, respectively

Test of Low Temperature Carbonisation Plant—The Director of Fuel Research has tested, in accordance with the scheme in vogue, the Turner plant for the low temperature carbonisation of coal, erected at the Comac Oil Co, Ltd, Coalburn, Lanarkshire In this retort the coal is heated internally by steam superheated to nearly 600° Penetration of the charge by steam and heat is ensured by frequent and sudden alternations of pressure on the retort To achieve this, the retort is made practically gas tight with an ingenious system of valves, automatically controlled, which is claimed to be an essential feature of the installation A Scotch coal of feeble caking properties was carbonised in the test, lasting nearly 5 days, without serious difficulty The yields per ton were Coke 12 2 cwt, tar 19 2 gal, spirit from gas 1 7 gal, gas 2400 cub ft of calorific value 790 B T U/cub ft The coke was readily ignited and suitable for use in normal domestic grates although not entirely smokeless It is not clear how much would be saleable for this purpose Fuel would be consumed in producing and superheating the large quantity of steam required This, after condensation, yields much liquor (464 gal/ton) probably of a character not welcomed by sewage and river authorities

Frank Buckland and Fish Culture

THE first course of public lectures on fishery subjects under the Buckland Foundation was given on Feb 24, 25 and 27 at Grimsby, and on Mar 24, 25, and 26 at Hull, by Prof W Garstang, of the University of Leeds, who holds the appointment of Buckland professor for 1930 Prominent members of the fishing industry presided over the six meetings, including Sir George Moody, Councillor A Bannister, and Mr G L Alward in Grimsby, and Mr A Cargill, Mr Percy Ross, and Lieut Colonel Hudson in Hull

Prof Garstang devoted his first lecture to a sketch of Frank Buckland's interesting personality, parentage, and career, and his remaining lectures to the bearings of modern scientific work on the problem of 'farming the sea', a dream which Buckland cherished and on which his pen was busy up to a few days before his death The lectures will shortly be published by the Trustees of the Buckland Foundation, 43 Parliament Street, London, S W 1 In the meantime, the following abstract will indicate the ground covered

Rather more than a hundred years have fled since Frank Buckland's birth (1826) and nearly fifty since his death (1880) His father was the celebrated Dr William Buckland, Dean of Westminster, formerly Canon of Christ Church and the first professor of geology in Oxford , his mother had artistic gifts as well as a great interest in natural history In the sixties and seventies of the last century, Frank Buckland was in the height of his powers, and was tireless in pressing upon his countrymen the importance of fisheries to the national welfare and the need of fuller knowledge bearing upon them His death at the untimely age of fifty four years was entirely due to the desperate exertions he made in January 1878 to fulfil a late but urgent request of the New Zealand Government for an additional consignment of salmon ova He succeeded, but never recovered from the effects of the prolonged exposure to icy water and driving snowstorms which he endured on this occasion

At his death, Buckland left to the nation his Museum of Fish Culture (now at South Kensington) and a reversionary sum of £5000 with which to endow a professorship of economic fish culture By this term, as shown by numerous passages in his later writings, Frank Buckland meant something much wider than fish hatching, for which he had an early enthusiasm, and meant all knowledge bearing on the practice, maintenance, and advancement of the fisheries By endowing these lectures he provided a means, never more needed than at the present time, by which additions to knowledge, however acquired, might be sifted, put together, and brought forward for the consideration of the fishing industry and the general public

An atmosphere of natural history surrounded Frank Buckland from his cradle, and was continued during his school life at Winchester After graduating at Oxford, and undergoing a surgeon's training at St George's Hospital, he took up a surgical commission, like his greater contemporary, Thomas Henry Huxley, but in the 2nd Life Guards, instead of in the Navy His chief interests, however, continued to lie in the behaviour of animals, whether kept as pets in the Deanery of Westminster or as inmates of zoological gardens, menageries, shows, and aquaria, or at large in duck pond and trout stream He set out with a great admiration for John Hunter, and aspired to emulate him in the creation of a science of comparative physiology , but he lacked true scientific method, and, his pen running away with him, his writings soon lost all trace of such an aim, and assumed a very diversified character, in which the racy and humorous elements tended more and more to preponderate

The loss of both his distinguished parents, for whom he had a deep veneration as well as affection, and the writing of his father's "Life" in 1858, brought to an end this phase in Buckland's career, as represented by his "Curiosities of Natural History", and he sought opportunities of turning natural history into more practical channels He took up acclimatisation, then fish hatching (1861), resigned his surgeoncy (1863), started *Land and Water* (1866), and in 1867 was appointed an inspector of fisheries, after which date he devoted practically all his time and energy to fishery duties and problems

The tasks which fell to the salmon inspectors of those days were thoroughly congenial to him, and his efforts to clear the rivers of numerous obstacles to salmon migration were remarkably successful, his earnestness and imperturbable good humour being great assets in negotiations with millers and land owners His 'practical natural history' was rewarded by a gratifying increase in the yield of salmon fisheries in almost every river in which his recommendations were adopted

Buckland's career was cut short too soon for him to mature his views on the more complex problems of the sea fisheries, but the idea of 'farming' the waters, as agriculturists farm the land, took early hold of his practical imagination In the last words he wrote on fishery matters, only two days before his death, he referred to the North Sea as a potential "Great Fish Farm", which only awaited more knowledge before it, too, like the rivers, could be brought under conditions of 'cultivation', as opposed to those of mere exploitation So far, it must be admitted it is a farm in which Nature has done all the sowing and man only the reaping

In the immense progress of marine science since Buckland's time, however, the conditions for a possible farming of the sea have become much clearer, as well as the limits set by natural factors Chief of these is the demonstration of the limiting factors to the annual crop of plant life in the sea, on which the stocks of fish ultimately depend In the elucidation of these difficult and highly technical questions, the staffs of the marine laboratories at Plymouth and Millport have played a very distinguished part

The invisible floating pastures of green diatoms depend, like other plants, on sunlight and 'manurial salts' (nitrates and phosphates), and both factors are subject to great annual and seasonal variations The outburst of diatoms in the spring may be exceptionally early or exceptionally late, thus hastening or retarding the development of the floating animal life (plankton), on which all larval, and some adult, fishes depend for their existence As the different species of fish have their special breeding seasons, these accelerations and retardations of the plankton may correspond with, or fail to overlap, the seasons when the fry of particular fish are being hatched and are seeking food Moreover, there is a natural 'disharmony' between the tendency of diatoms to float and multiply in the illuminated upper waters, and the downward gravitation of the main sources of manurial salts Gales and temperature changes mix up the various water layers in winter, so that the year starts with an even distribution of the nitrates in the sea from top to bottom , but the spring outburst of diatoms quickly uses up the nutritive salts in the upper layers, and unless there are timely summer gales to bring up fresh supplies from the bottom, the diatom pastures rapidly dwindle, in spite of the increasing power of the solar rays

Thus arise good and bad years for the replenishment

of the stocks of fish, and, unless and until man devises the means of regularising the supply of nutrient salts in the surface waters, these natural fluctuations are inevitable and uncontrollable. Who can disperse the clouds below the sun, or modify the incidence of summer storms?

Science is not quite helpless even under these conditions, for, as the age of individual fishes can now be determined, the effects of good and bad years, when the data are adequate, can be traced to their causes, and can be followed in the actual stocks of fish through considerable cycles of years. It is thus becoming possible to predict from the age composition of a stock of herring, haddock, etc., in a given year and its predecessors, what it is likely to be in the ensuing season. In this way Mr. Hodgson, of the Lowestoft Laboratory of the Ministry of Fisheries, last September made a remarkably close forecast of the autumn herring fishery, and leaders of the industry have already expressed their appreciation of the commercial value of such forecasts. To be forewarned is to be forearmed, and may mean the annual saving of many thousands of pounds in an industry which requires large anticipatory provision of apparatus, stores, and personnel.

From the point of view of farming the sea, the magnitude of modern fishery operations is a fact of cardinal importance, since the collective power of the fishing fleets is no longer negligible in comparison with the blind forces of Nature. It was formerly thought that this power was merely destructive; but the problem is one of dynamics, not statics, and the destruction entailed by fishing is now known to be balanced by an increased rate of production. It is the quality rather than the quantity of fish that is changed by it. Like the destructiveness of Nature, that of the fishing fleets operates as a selective agency, and is creative of new conditions some of which are manifestly beneficial. It is possible that the hosts of herring have been actually increased in consequence of the elimination by trawlers of the large haddocks which feed upon their spawn. It is certain that the removal of old plaice favours the survival and growth of the young, the precise nature of the result depending also on a further factor, the greater or less amount of local reproduction. In the Cattegat and Baltic, where reproduction is limited, the effect of intense fishing is seen in a great increase in the growth rate, coupled with a reduction in numbers, thus raising the average size. A race of small, slow-growing and worthless fish has been converted into one of large, quick-growing and valuable fish, but it is feared that the rate of reproduction is insufficient to meet the steady reduction in numbers.

On the other hand, in the North Sea, with a high rate of reproduction, the effect of intense trawling is to increase the survival of the young and their emigration offshore, so that the increase of their growth rate is checked at a certain level by additional numbers. The increase of small fish in the catches, formerly regarded as evidence of 'over-fishing', is really the greatest safeguard against it, for it means that, however intense the fishing, the gaps are immediately filled from inexhaustible reserves.

If these arguments are soundly based—and the recent experience of post-War changes overwhelmingly supports them—the North Sea problem is reduced to the question of how to increase the average size of the fish without reducing the intensity of fishing. So far as the plaice is concerned, the answer is already available.

One of the first results of scientific investigation of the North Sea was to show that the Dogger Bank, with an area as large as Wales, lies outside the track of normal plaice migration, and yet possesses enormous reserves of the favourite food of this fish. The one unimpeachable method of raising the size of plaice in the North Sea is to utilise this great reserve for the purpose, and to transplant every year some millions of the small overcrowded and slow-growing fish from the coastal banks to this great feeding ground, on which it has been shown repeatedly that the plaice transplanted grow three, four, and even six times as rapidly as on their native shores.

Science is useless without enterprise. Great Britain looks to the traditional enterprise of the great Humber fishing ports to take up this matter as a commercial proposition. Let Grimsby and Hull take the first step towards cultivating the 'Great Fish Farm' which lies at their very door.

Opening of the Forest Research Institute at Dehra Dun, India

THE February issue of the *Indian Forester* is a commemoration number devoted to a detailed account of the opening of the new buildings of the Forest Research Institute at Dehra Dun, India. A brief announcement of this event has already appeared in NATURE (Nov. 16 and 30, 1929).

The new main building was opened by the Viceroy on Nov. 7, 1929. Perhaps the most important part of Lord Irwin's speech was his allusion to the work of the expert committee appointed under the presidency of Sir Chunilal Mehta "to advise them about the functions and policy of the Institute and the future of its activities". The report of this Committee was presented and made public last summer and the Viceroy explained some of its recommendations as follows: "In the report they made a number of most helpful suggestions and laid down, with admirable judgment and lucidity, the line of policy which should be pursued in the future. ... I am happy to be able to say that the bulk of their recommendations have already been taken up in consultation with Mr. Rodger and that we hope to give effect, in due course, to very many of them. We intend within the limits of our financial liability to give this Institute, now so finely housed and located, the scientific staff which it requires, and to omit or neglect no measure which we think will make for its continued success and greater usefulness.

"The Institute and the various allied activities of which it is the centre, must, as I see it, aim at the discharge of a double purpose. On the most effective utilisation of Indian woods, I have already spoken, but it is not less our desire to train Indian personnel in all the technical branches of forestry research work. The governing consideration must remain that of efficiency."

Mr. (now Sir Alexander) Rodger, Inspector General of Forests and president of the Forest Research Institute, in his address of welcome to the Viceroy and Lady Irwin, pointed out that Dehra Dun has been the centre for forest work since 1878, when a forest college was founded for training rangers and foresters. Forest research work has been in close touch with education since 1906, when the Research Institute was inaugurated, though, as a matter of fact, in two branches, chemistry and forest zoology, the ranger class had the benefit of lecture courses from research officers several years antecedent to 1906. Sir Alexander alluded to the enormous expansion in personnel since 1906. In the latter year there were five gazetted officers and one non-gazetted officer appointed to the charge of the six branches into which

forest research was subdivided. Each officer had a small clerical staff allotted. In 1929 the staff had expanded until the Institute now employs thirty-five gazetted officers, two hundred and twenty assistants and subordinates, and three hundred and fifty men on daily labour. It is this great development which necessitated the construction of the great buildings opened by the Viceroy on Nov. 7.

In 1906 no special accommodation was available. The first large building was erected at Chand Bagh and opened in 1914. It was confidently expected that this building would suffice for all possible requirements of the Institute for a number of years to come. The development of the forest resources of India made such strides during the War that the Industrial Commission pointed out in 1918 the necessity of expanding the Institute to meet the rapidly increasing demands of the country. The Commissioners advocated the increase of the number of research officers and stated that the equipment provided was entirely inadequate. These recommendations were accepted by both the Government of India and the Secretary of State and, in spite of later suggestions for cutting down the scale of the new proposals, they survived the ordeal. The workshops of the economic branch were completed and in working order in 1924 and the main building was occupied during the years 1926 and 1928. The total cost of the new establishments is close upon one million pounds.

The three most handsome rooms in the Forest Research Institute are the new library, in Andamans padauk, the large hall, all Burma teak, and the entrance hall, shisham and rosewood. Another room which is very effective is the office of the forest economist, which is panelled in poon (*Calophyllum*) from Madras. The other rooms are not so decorative, but, as Burma teak of good quality has been used throughout, they are mostly handsome as well as useful. A special feature has been made of the windows, with good lighting for laboratory work. There are six museums, with floor space of 26,000 square feet, and the ordinary rooms designed for laboratories and offices cover about 63,000 square feet.

In the grounds, besides the workshops of the economic branch are offices for the different branches and numerous residences of all kinds for the staff.

As at first arranged, the buildings at Chand Bagh were to be utilised as the training centre for the Indian probationers for the Indian Forest Service whose two years' course of training in forestry is now being given at Dehra Dun. It was perhaps too much to hope to keep Chand Bagh in the Department, even though so much forest history has grown up around it. The beautiful building is to be given up and it is to be utilised in the future for medical research work, while part of the new Institute building will be devoted to the educational requirements of the Indian Forest Service probationers.

The chief value of this commemoration number of the *Indian Forester*, for the future, will not be confined to the account of the opening proceedings of the new buildings. For the latter is followed by a valuable detailed account of the past history and development of the various branches of the Institute from the date of its inauguration in 1906.

Archæology from the Air in Central America

THE definitive account of the recent archæological reconnaissance by air in Central America, to which reference has already been made in our columns (see NATURE, Dec. 28, 1929, p. 995) appears in the April number of the *Geographical Review* (New York). The authors are Mr. Oliver J. Ricketson and Dr. A. V. Kidder, who acted as observers. The text is illustrated by a number of photographs taken by Mr. Ricketson and Mrs. Lindbergh. As previously noted, the leader of the expedition was Col. Lindbergh, who originally suggested the idea of the reconnaissance to the Smithsonian and Carnegie Institutions.

To enable their readers to appreciate the significance of the observations on the four flights which were made, the authors recapitulate the main divisions and distribution of the remains of ancient Maya civilisation. The oldest remains are found at Peten in Guatemala, whence the city-building activities of the Maya were carried to what is now British Honduras and Yucatan. The classic period of the Old Empire, lasting from about the beginning of the Christian era to 610, was followed by a migration to lands of which northern Yucatan became the most important. There a renaissance took place in the eleventh and twelfth centuries which is marked by the magnificent buildings of Uxmal and Chichen Itzá. Later, the Mexicanisation of Maya art and religion, after the calling in of the Nahua tribes, led to a time of vigorous growth and building activity followed by a hundred years of decadence which ended with the Spanish conquest.

A great deal of the country which was thus occupied is still unexplored. Short of cutting a way through the almost impenetrable bush, the only means of access are the paths of the *chichle* gatherers (*chichle* is the sap which forms the basis of chewing gum). Although these paths are gradually opening up the country, they still do not join, and the country lying between is unknown. As travel by bush path gives no opportunity for topographical observation, the general aspect, geographical features and contour of the Maya country are not known. As became apparent from the observations made on these flights, the existing maps are untrustworthy as regards the situation of natural features, existing settlements, towns, and ruins. Several unmapped natural features were recorded for the first time.

The flights began on Oct. 6, 1929, and a flight was made on each subsequent day up to and including Oct. 10. On the last day, however, comparatively little time was spent in archæological observation as the party flew to Havana and Miami. The flights were usually at an altitude of 500 feet, as this was found the best for observation, and the average speed was 85 miles per hour. The difficulties of observation owing to the density of the vegetation will be appreciated from the fact that on several occasions the aeroplane circled and recrossed known sites without the observers being able to 'spot' the ruins. It was desired to follow the great causeway which runs for at least fifteen miles from Coba, but although the exact spot at which it leaves the city was known, it could not be found.

The flight on Oct. 6 was from Belize to Merida, a distance as flown of 454.8 miles, the time taken being 5 hr. 21 min. Owing to the inexperience of the observers, observation on this flight was found difficult, but as time went on rapidity and accuracy were found to come with experience. After spending the night at Merida, the party returned to Belize on Oct. 7 by a slightly shorter route, ending with a flight along the coast, the distance covered being 373 miles in 4 hr. 23 min. On this flight, Chichen Itzá and Yaxuna were visited and a landing made at Lake Payegua. On Oct. 8 a flight was made to Flores, the return being by the southward of the Cockscomb range. On this journey Yaxha, where a landing was

made, Nakun, Tikal Lake, Peten, and Peten Forest were visited—443 miles in 5 hr 14 min flying The flight of Oct 9 to Cozumel, which occupied 5 hr flying time, was archæologically the most productive Not only did the party fly over sites already known, such as Tzibanché, an Old Empire site discovered by Dr Gann in 1927, but on several occasions ruins, pyramids, and buildings were sighted which were entirely unknown before Of these one was of considerable size After a night at Cozumel, flight was resumed to Coba, and thence, as previously stated, to Havana and Miami

In summing up the results of the experiment, the authors express their opinion of the great advantages of the exploration of this country by air There is obviously an immense advantage to be gained in time In twenty one hours of archæological flying, they covered about 1780 miles The time it would have taken to cover the same country on the ground is incalculable Some areas could not have been reached at all, while others could have been reached only by a large and expensively equipped expedition Not only, therefore, does this method of exploration make possible geographical and topographical observation otherwise impossible, but the advantage in time to the excavator if a practical method of organising transport could be devised would be an enormous gain Both the authors and Col Lindbergh are convinced that an air survey of the region is both feasible and desirable It is estimated that a complete survey would occupy about five months Col Lindbergh is prepared to give every assistance in his power towards carrying out this project In the interests of American archæology, it is to be hoped that a generous benefactor may be found to finance the undertaking

University and Educational Intelligence

Oxford —The proposal to use the money set free by the sale of the present site of the Radcliffe Observatory for establishing an observatory in South Africa is advocated by the Savilian professor of astronomy, Prof H H Turner The grounds on which the plan commends itself to astronomers are stated by him to be chiefly two first, the extreme uncertainty of the Oxford climate, together with the facilities which now exist for rapid communication, and secondly, the importance of supplying fresh centres of observation in the southern hemisphere, where much work will have to be done to catch up with that already carried out for the northern skies The disappearance of the old Radcliffe Observatory will be regretted on sentimental grounds, but there would appear to be no question of the scientific advantages to be gained by the present proposal of the trustees

Applications for grants from the Dixon Fund for scientific research must reach the Academic Registrar of the University of London, South Kensington, S W 7, by May 15

Grants from the Thomas Smythe Hughes and Beaverbrook medical research funds of the University of London will shortly be made Applications should reach the Academic Registrar of the University, South Kensington, S W 7, by June 15

Senior industrial bursaries for assistance in practical training in engineering are being offered by the Company of Armourers and Brasiers and applications for them should be sent before May 31 to the Clerk of the Company, Armourers' Hall, 81 Coleman Street, E C 2

Historic Natural Events

April 27, 1682 Thames Flood —Under this date, Viscountess Campden wrote to her daughter, the Countess of Rutland "Never was such flodds known as has bine here, howses drowned and pore children drowne in theare cradels swimen up Fleet Bridge, and there taken up, and tables and hogeds full of beare and all washed away, and peoppele geting up to theare lofts and hole heards of hogs drowned, and so Roger Pratt comeing from Norfolke narely escaped drownding and logers in Fleet Dich drowned, that never such a flood was known, that it is impossable for me to returne till the watters falls"

April 27, 1894 Earthquake in North-east Greece —A week earlier, on April 20, a strong earthquake occurred in north east Greece, by which 224 persons were killed and houses were damaged over an area of 1760 sq miles The earthquake of April 27 was much stronger, houses being overthrown within an area of 3000 sq miles With this earthquake, crust movements occurred along a fault, about 35 miles long, running in a constant west north west direction parallel to the Gulf of Eubœa The Plain of Atalante, on the north east side of the fault, was shifted slightly to the north west, and depressed by an amount, usually small, but in places by as much as 5 feet

April 29, 1697 Thunderstorm —A violent thunderstorm occurred over Snowdon and in north west England, accompanied by hail, over a tract two miles wide and sixty miles long Hailstones weighed five ounces, and broke nearly all the windows, killed many fowl, poultry, and sheep, and destroyed the green corn

April 29, 1882 Gale —During the progress of a deep cyclonic system north eastwards across England, a gale occurred which was unusually severe for so late in the spring The gale blew from south west and west, and was general over the south and east of England and the north of France Much damage was done to the young spring foliage, the leaves being in many cases completely blackened, as though singed by fire This effect was probably due to mechanical injury caused by the high wind, but was attributed by some observers to the action of sea salt, crystals of which were clearly traceable upon many of the leaves

April 29, 1892 "Malartic" Cyclone —A very violent tropical cyclone struck Mauritius, the centre passing directly over Port Louis, where an enormous amount of damage was done An interesting feature was the overthrow of "Malartic" monument, a column 49 feet high built of stone blocks The upper part of this column, 26½ feet high, and 5 feet 3 inches across at the base, was overthrown by the wind, and it was afterwards calculated that the wind pressure to achieve this must have reached 142 lb per square foot, equivalent to a velocity of more than 200 miles per hour The highest wind velocity recorded at the Pamplemousses Observatory was 123 miles per hour

April 30, 1575 Frost and Flood —Holinshed records that "all the lochs, rivers, and all manner of other waters were frozen in Scotland, from the beginning of November till the latter end of April, and when the frost brake and the snows melted, there was such a flood flowing over all the plains even to the roots of the mountains as the like had not been seen Furthermore, when the same shrunk and went away, in the mud and slime there was such a sort of frogs left that when they were dead and began to putrefy the air was so infected that many deadly diseases

issued, whereof great numbers of the inhabitants did perish " In France the winter was equally severe, no man living had seen the like, and the snow fell in such quantity that the forests were inaccessible and people could not obtain wood Horses and men perished in great numbers, and the cold was succeeded by famine and pestilence which, it is said, destroyed almost a third of the population Similar effects were felt in Italy and Germany, and the Rhine was frozen for a long period

May 1, 1594 Wet Summer began—The weather was unusually wet and unseasonable from the beginning of May until July 25, this was followed by dearth This is believed to be the summer described in "A Midsummer Night's Dream", Act 2, Scene 1

> The ploughman lost his sweat, and the green corn
> Hath rotted ere his youth attained a beard
> The folds stand empty in the drowned field
> And crows are fatted with the murrain flock,
> The nine men's morris is filled up with mud

May 1, 1908 Intense Rainfall in Panama—A downpour of unrivalled intensity occurred at Porto Bello (Panama) Owing to the indistinctness of the autographic record caused by the excessive accumulation of water, there is some doubt as to the exact amount, a conservative estimate gives 2 48 inches of water in five minutes, but another figure often quoted is 2 47 inches in three minutes Either figure constitutes the heaviest fall of rain ever recorded in that time

May 3, 1605 Glacier Advance—The inhabitants of Chamonix presented a demand for reduction of taxes, on account of the damage done by "glaciers, the river Arve and other torrents" The damage was due especially to abnormal advances of the glaciers

May 3, 1849 Cloudburst—At 5 30 P M during a storm of thunder, lightning, and hail, an enormous body of water rushed down a gully in Bredon Hill, North Gloucestershire, towards the village of Kemerton The stream was broad and impetuous, carrying everything before it On reaching the residence of the Rev W H Bellairs, of Kemerton, it broke down a stone wall which surrounded the garden, burst through the foundation of another, made a way for itself through the dwelling house, and then carried off a third wall of brick six feet high The garden soil was washed away, and enormous blocks of stone and debris from the hill left in its place It flowed through the house to the depth of three feet for an hour and forty minutes The neighbouring railway was so deeply flooded as to delay the express train by extinguishing the fire of the engine The course of the torrent could easily be traced up the hill for more than a mile, to a barley field of five acres, the greater part of which was beaten down flat and hard, as if an enormous body of water had been suddenly poured out upon it Beyond this there were no signs of the fall of water to any great amount

May 4, 1697 Hailstorm—A violent thunderstorm, accompanied by a south westerly gale, began at Hitchin, Herts, at 9 A M and continued until 2 P M Some of the hailstones which fell during the storm were reported to be thirteen or fourteen inches in circumference; the hail split great trees and destroyed several hundred acres of wheat, and at Sir J Spencer's, 7000 panes of glass were broken On the same day a noteworthy hailstorm occurred also in Staffordshire, in which the hailstones were reported to be nearly twelve inches in circumference. The ground was torn up, and there were at least 100,000 cartloads of hailstones

Societies and Academies

LONDON

Geological Society, Mar 12—**R W Pocock** The age of the Midland basalts Data bearing on the age of the various igneous masses in the Upper Carboniferous are brought together The conclusion is reached that the Shropshire and South Staffordshire basalts are of the same general age namely, Yorko Staffordian, whether extrusive or intrusive A volcanic belt is known to traverse the Midlands from Hanter and Stanner in Radnorshire to the Ashby Coalfield area The main movement along this zone took place in Yorko Staffordian time, and the basaltic masses in question are, without exception, situated along it—**Thomas Robertson** The origin of the Etruria Marl The Etruria Marl Group of the Upper Coal Measures in the Midlands is mainly composed of chocolate coloured to purple clay, mottled with green, yellow, etc, alternating with greenish sandstones (Espley Rock) In appearance and composition the Etruria marl strongly resembles the denudation products of basalt and basic tuff, and further examination shows that it contains fragments of basalt, that its position in the geological sequence is the same as that of the Coal Measure vulcanicity in the Midland Province, and that it is best developed in those portions of the basins of deposition towards which the denudation-products of the Midland basalts would flow

PARIS

Academy of Sciences, Mar 17—**S Winogradsky** The synthesis of ammonia by the soil *Azotobacter* The cultivation of this organism in a mannite medium has, with one exception (Kostytschew), never given rise to ammonia The author now shows that if means be taken to increase the pH of the medium to between 8 and 9, ammonia can be detected in the atmosphere above the culture—**Giuseppe Cesàro** was elected a *Correspondant* for the Section of Mineralogy—**Vladimir Bernstein** Correction concerning the series of Dirichlet—**Baule** A method of navigation based on automatic route tracing—**V Schaffers** The earth connexion of lightning rods—**Maurice Lambrey** The two normal states of the NO molecule For a layer of nitric oxide of constant thickness, the optical density of the γ bands is proportional to $p^{1\ 81}$, whilst the optical density of the β-bands is sensibly proportional to the pressure—**Mlle Jacqueline Zadoc-Kahn** The magnetic double refraction of para azoxyanisol at temperatures above the point of disappearance of the mesomorph state The measurements were made with the Bellevue electromagnet in a field of 40,700 gauss The high value of the magnetic double refraction found and its rapid variation with temperature agree with the views of G Föex—**A Blanc** The photo-electric phenomena of solutions of potassium ferrocyanide—**Adolphe Lepape** and **Marcel Geslin** The radioactivity acquired by materials exposed to the action of atmospheric agents The materials examined, lead, zinc, slate, and deposited dust, were obtained from the roof of the Collège de France, and all emitted a very absorbable radiation (α-rays) The activity of the lead is higher than that of the zinc, but practically equal to that of the slate It is concluded that the radioactivity is due to substances derived from the air—**Jean Savard** The ultra-violet absorption spectrum of aniline vapour.—**Al Yakimach**: Complexes of quadrivalent manganese cyanide Description of the preparation and properties of a potassium manganicyanide, $K_4Mn(CN$ [illegible] **Lespieau** and **Deluchat**, Paradivinylbenzene paradiacetylenylbenzene—**Georges Brus** and **G Pe[illegible]blanques** The fixation of ozone by benzene linkages

and by acetylene linkages The ozonisation curves distinguish readily non benzene double bonds, benzene linkages and triple bonds —**Raymond Chevallier** The permanent magnetisation of the lavas of Iceland and of Jan Mayen —**Schribaux** The factors of the baking value of wheat —**Mlle Simone Mouchet** The mode of formation of the spermatophores in *Pagurus* —**R Fosse, A Brunel, and P de Graeve** The estimation of uric acid, based on the urea produced by fermentation and hydrolysis —**Fernand Caujolle and Jean Molinier** The influence of the fatty amines and their chlor hydrates on the amylolytic activity of the saliva and of pancreatine

Brussels

Royal Academy of Belgium, Oct 12 —Cl Servais The geometry of the tetrahedron (4) —**Victor van Straelen** The Jurassic decapod crustaceans of eastern Greenland —**M Dehalu and P Swings** Note on a method of star photography based on the measurement of the opacities of photographic tracks By a slight adjustment of the mechanism driving the equatorial telescope, the image of each star is made to appear as a short line of about 1 millimetre in length, and the opacity of this line is measured with a recording photometer The method should prove especially useful for the fainter stars —**P Gilard and P Swings** A simple method of determination of the absorption of glasses in the ultra violet region of the spectrum The method described has been applied to five glasses It is shown that the addition of nickel oxide makes the glass more permeable to the ultra violet, and that increased transparency results from the replacement of calcium oxide by barium oxide —**E Asselberghs** Note on the marine fauna of the Gedinnian of the Ardennes —**F Govaert** Contribution to the study of the nitration of *o* fluorbenzoic acid The main product of the nitration of *o* fluorbenzoic acid is the 1 2 5 fluornitrobenzoic acid, about 5 per cent of the 1 2 3 isomer being also formed —**R H J Germay** The equation of Gauss —**Maurice Nuyens** A new method of integration of the gravific equations with spherical symmetry —**D V Jonesco** Some problems relating to a formula of recurrence or to a finite difference equation —**Th Lepage** Certain differential forms associated with equations of the Monge Ampère type arising from the calculus of variations —**Raymond Defay** The thermodynamical study of surface tension affinity and adsorption velocity —**Louis van den Berghe** Note on deglutition in the Cyprinidæ

Rome

Royal National Academy of the Lincei, Dec 1 —Guido Ascoli Approximate representation of a function by means of linear combinations of given functions —**E Bortolotti** Geodetic co ordinates along a line (2) —**B de Finetti** Integration of functions with aleatory increment —**G Sansone** Surfaces applicable to surfaces of constant mean curvature New demonstration of Ricci's theorem —**B Segre** Existence of distinct continuous systems of plane algebraic curves with given Plueckerian numbers In continuation of the author's recent communication on questions relating to the existence and dimensions of continuous (irreducible) systems of plane algebraic curves with given characters, it is now shown that there may exist several distinct complete continuous systems (even of different dimensions) of irreducible algebraic curves with given Plueckerian characters Certain applications of the theory of continuous systems are also considered —**M Picone** The interval of indetermination of Poisson's summation procedure for Fourier's and Laplace's systems —**Pia Nalli** Rigid displacements and generalised derivatives —**A Gelfond** A theorem of G Polya —**G. Boaga**: Simple rapid topographical procedures —**N Passerini**: Minimum temperatures at different small heights above the ground Observations made at the Meteorological Observatory of Pisa between June 1, 1924, and June 30, 1927, show that, with rare exceptions, the minimum temperature during the twenty four hours increases from 0 05 m to 2 m above the ground The extreme differences may exceed 3°, and in one instance (Jan 3, 1925) reached 4 5° In most cases the minimum readings at 0 05 m and 1 m show a greater difference than those at 1 m and 2 m —**Rita Brunetti** Variations of crystalline polychroism under the influence of the electric field —**E Segrè** Anomalous dispersion in band spectra —**A Ferrari and C Colla** Crystalline structure of neutral carbonates of cobalt and nickel Normal cobalt carbonate exhibits rhombohedric structure of the 'calcite' type, the dimensions of the unit cell, which contains four molecules being $a = 5\ 91 \pm 0\ 005$ A, $\alpha = 103° \ 22'$, the density is 4 24 Unlike the cobalt salt, natural normal nickel carbonate has never been found, although nickel compounds are more widely diffused than those of cobalt Preparation of nickel carbonate by various synthetic methods employed has not been found possible —**V Zagami** Muscular phosphogen in fish Experimental results are given which indicate the existence of a direct relationship between the phosphogen content of the muscles of fishes and the degree of activity and muscular strength as regards swimming In other words, migratory and strong swimming fish contain more phosphogen in their muscles than stationary fish or those that swim less Moreover, the caudal region always contains more phosphogen than the cranial region The more highly the dental apparatus of the fish is developed, the greater is the proportion of phosphogen in the masseter muscle in comparison with that in other muscles of the same organism —**R Savelli and N Soster** Provocation of monophylly in *Cannabis sativa* L by means of wounds

Sydney

Royal Society of New South Wales, Dec 4 —M B Welch (1) Some mechanical properties of Australian grown *Pinus insignis* (2) Whilst considerable variation occurs, the wood is by no means brittle and devoid of strength as is commonly believed Whereas the denser Gosford wood closely resembles in every respect pitch pine, the lighter and milder South Australian wood possesses the characteristics of the clear and sugar pines It seems, therefore, that by proper grading, *Pinus insignis* can be obtained for most of the purposes for which imported softwoods are used, provided, of course, that it can be obtained in length free from defects —(2) Some properties of red satinay, *Syncarpia Hillii* This is a close textured reddish coloured timber occurring in large quantities on Fraser Island, off the Queensland coast, but is little known on the Sydney market The wood is very durable, borer and white ant resistant, and is also remarkably difficult to burn The weight, about 52 lb per cubic foot, precludes its use for many purposes, but where this factor is not important the wood should be useful It works crisply and does not splinter easily, and with the added advantage of fire resistance should make an excellent flooring timber, whilst figured logs are very suitable for veneer The wood requires little filler and readily takes a high polish It is, however, inclined to be brittle and is not suitable for positions requiring toughness —**L L Waterhouse and W. R. Browne** Note on an occurrence of quartzite containing common opal and chalcedony at Tallong, N S W The rock overlies a Permo-Carboniferous sandstone

and is itself overlain by Tertiary basalt It is considered probable that the quartzite was originally a Tertiary sand derived from the underlying sandstone, and that silica was added mainly from volcanic sources The cementing material is in the forms of quartz, common opal, and chalcedony, and there are veinlets through the rock lined with opal and filled with chalcedony The order of deposition, quartz, opal, chalcedony, was probably one of decreasing temperature, no sign of a transition from opal to chalcedony was observed —G D Osborne and H G Raggatt Some interesting geological faults in the vicinity of Branxton, N S W The stratigraphy of the Upper Marine rocks exposed in a railway cutting near Branxton is described and a detailed account of the faults intersecting these beds is given There are nine faults, seven being of overthrust type The displacement in each case is small A consideration of the strike, dip, and general features of the thrusts leads to the conclusion that they were produced in Post Palæozoic time when the area was subjected to the crustal compression which culminated in the development of the Hunter Overthrust —Miss J Chalmers and J C Earl Studies on the hydrolysis of cellulose (1) By using a boiling 5 per cent solution of hydrogen chloride in methyl alcohol, it has been possible to accomplish a graded breakdown of cellulose triacetate Properties of some intermediate products are placed on record —Francis Lions (1) Some trimethoxy quinoline derivatives 1 Acetyl 2 4 dimethyl 5 6 7 trimethoxytetrahydro quinoline and 1 acetyl 2 4 dimethyl 6 7 8 trimethoxytetrahydro quinoline have been synthesised from 3 4 5 trimethoxy aniline and 2 3 4 trimethoxy aniline respectively by condensation with acetylacetone followed by ring closure, reduction, and acetylation —(2) Researches on indoles (1) 6 Acetylamino eugenol methyl ether obtainable from eugenol methyl ether by nitration and reduction followed by acetylation, readily yields a dibromide ($C_{13}H_{17}O_4NBr_2$), which on treatment with concentrated alcoholic potash is converted into 2 methyl 5 6 dimethyoxindole — H Finnemore and C B Cox Cyanogenetic glucosides in Australian plants (2) An examination of the 'native fuchsia' has shown that the cyanogenetic glucoside, which was present in the remarkably high amount of 10 per cent in a sample of air dried leaves from Queensland, is identical with prunasin, which has been previously prepared by the controlled hydrolysis of amygdalin, and is found in Nature in the drug *Prunus serotina*

Official Publications Received.

BRITISH.

Air Ministry Aeronautical Research Committee. Reports and Memoranda. No 1282 Full Scale Experiments on High Tip Speed Airscrews Comparative Performance Trials of Three Airscrews of Different Sections By W G Jennings (T 2864) Pp. 6+5 plates 6*d* net No. 1217 (Ae. 376) Conditions for the Prevention of Flexural torsional Flutter of an Elastic Wing By R. A. Frazer and W J Duncan (T 2704 and a.) Pp 16. 9*d* net. No 1276 (Ae 422) The Effect of Span on Aircraft Performance By W G Jennings, in collaboration with Messrs Boulton and Paul (T 2802 and a) Pp 17+11 plates. 1*s*. net. (London H M Stationery Office)

The Gardens Bulletin, Straits Settlements. Vol. 6, Part 2 Malay Village Medicine Prescriptions collected by I H Burkill and Mohamed Haniff Pp 167 321 (Singapore Botanic Gardens.) 2 50 dollars

Transactions of the Optical Society Vol. 30, No 5, 1928-29 Pp 185 272+xiv (London) 10*s*

The Institution of Professional Civil Servants Annual Report of Council for the Year 1929 Pp. xiii+55 (London)

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society Edited by H Munro Fox. Vol 5, No. 2, April Pp 91 176 (Cambridge At the University Press) 12*s*. 6*d* net

Board of Education. Vacation Courses in England and Wales and Scotland, 1930. Pp. 26 (London H M Stationery Office). 6*d*. net.

Reports of the Council and Auditors of the Zoological Society of London for the Year 1929, with an Appendix on the Centenary Celebrations, prepared for the Annual General Meeting to be held on Tuesday, April 29th, 1930, at 4 p.m. Pp. 119. (London)

FOREIGN

Publications of the Astronomical Observatory of the Warsaw University Vol 5 Pp iii+76 (Warsaw)

Deutsche Forschung aus der Arbeit der Notgemeinschaft der Deutschen Wissenschaft Heft 1 Pp 116 (Berlin)

The University of Colorado Studies Vol 17 No 4 Pp 269 431 (Boulder, Colo)

Review of Legal Education in the United States and Canada for the Year 1929 By Alfred Z Reed Pp iii+72 (New York The Carnegie Foundation for the Advancement of Teaching) Free

U S Department of Commerce Coast and Geodetic Survey Serial No 453 United States Magnetic Tables and Magnetic Charts for 1925 By Daniel L Hazard Pp ii+136 (Washington, D C Government Printing Office) 60 cents

Smithsonian Institution Bureau of American Ethnology Bulletin 91 Additional Studies of the Arts Crafts and Customs of the Guiana Indians with Special Reference to those of Southern British Guiana. By Walter E Roth Pp xvii+110+34 plates 1 dollar Bulletin 93 Pawnee Music By Frances Densmore Pp xviii+129+8 plates 90 cents (Washington, D C Government Printing Office)

State of Connecticut Public Document No 24 Fifty second Report of the Connecticut Agricultural Experiment Station, New Haven, for the Year 1928 Pp xl+862+xxx (New Haven Conn)

National Research Council Organization and Members 1929-1930 Pp 65 (Washington, D C National Academy of Sciences)

Proceedings of the American Philosophical Society Vol 68, No. 4 1929 Pp xix+275 320 Vol 69, No 1 1930. Pp 17 (Philadelphia)

U S Department of Commerce Bureau of Standards Bureau of Standards Journal of Research Vol 4 No 2 February Pp. 177 327 (Washington, D C Government Printing Office) 40 cents

CATALOGUES

Judex Analytical Reagents and Laboratory Chemicals Pp 72 (London The General Chemical and Pharmaceutical Co, Ltd)

Cambridge Instruments for Hydrogen ion Measurements (List No 108) Pp 24 (London and Cambridge Cambridge Instrument Co Ltd)

The Creation of a Microscope Objective in the Rathenow Works of Emil Busch Optical Company Pp 20 (London Emil Busch Optical Co, Ltd)

Diary of Societies

FRIDAY APRIL 25

FARADAY SOCIETY (at Chemical Society), at 3 15 —Annual General Meeting

ROYAL SOCIETY OF MEDICINE (Medicine Section) at 5 —Cinematographic Demonstration by Dr L G Rowntree Ganglionectomy in Chronic Arthritis —Prof Dixon and Dr G N Myers The Curative Action of Digitalis in Toxæmia.

INSTITUTION OF MECHANICAL ENGINEERS, at 6 —W Nithsdale The Design and Results of a 600 lb per sq in Boiler Installation

ROYAL SOCIETY OF MEDICINE (Epidemiology Section) at 8 —Prof S L Cummins Some of the Clinical and Pathological Factors underlying Mortality Rates in Tuberculosis

INSTITUTION OF ELECTRICAL ENGINEERS (West Wales (Swansea) Sub Centre) —S W Melsom A N Arman and W Bibby Surge Investigations on Overhead Line and Cable Systems

SATURDAY, APRIL 26

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Newcastle upon Tyne), at 2 30 —G E Tansley The Value of the Economiser in Present Day Boiler Installations — Paper open for further discussion —Notes on a Winding Accident at Mainsforth Colliery, C Howson

BRITISH PSYCHOLOGICAL SOCIETY (at University College), at 3 —Dr O A Oeser A Critical Examination of Kohler s Gestalt Psychology — G C Grindley Psychological Factors in Peripheral Vision —Miss M D Vernon A Photographic Study of Eye Movements in Reading

MONDAY, APRIL 28

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4 30 —Rev Dr H C Morton The Concept of Evolution in the New Psychology

INSTITUTE OF ACTUARIES at 5 —P N Harvey Notes on the Relative Mortality of Married Men and on an Experiment in Forecasting Mortality over a Limited Period

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8 —Prof A E Richardson Architects Drawings of 1800–1850

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8 —F Coleman Buried Mandibular Teeth with Crowns in Occlusion —Mrs. May Mellanby Some Further Investigations on Man and Animals, into the Causes of Dental Disease, with Special Reference to Factors Controlling the Resistance of the Dental Tissues to Harmful Agencies

TUESDAY, APRIL 29

ROYAL SOCIETY OF ARTS (Dominions and Colonies Section), at 4 30

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5 —Prof J J R. Macleod Diabetes as a Physiological Problem (Oliver Sharpey Lectures) (1).

INSTITUTION OF CIVIL ENGINEERS, at 6 —E T Ward The Navigability of the Lower Danube.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7 —J Durward Air Photography Surveys. —Dr F M Hamer and O Bloch The Optical and Photographic Properties of Certain Dyes of the Thionine and Related Types —A S. Newman Demonstration of H and D Exposure Machine —O. J. Wilkinson Concerning Photography in the Gangetic Delta

ROYAL ANTHROPOLOGICAL INSTITUTE (jointly with Folklore Society), at 8.30 —Dr M Gaster Roumanian Art and Handicraft in Relation to the Balkan Peoples.—Mrs. Murgoci Description of the Collection of Roumanian Folklore Objects on Exhibition

WEDNESDAY APRIL 30

GEOLOGICAL SOCIETY OF LONDON, at 5 30.—Emily Dix and Dr A. E. Trueman Some Non Marine Lamellibranchs from the Upper Part of the Coal Measures —Emily Dix The Flora of the Upper Portion of the Coal Measures of North Staffordshire
NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at 17 Fleet Street) at 5 30 —Major E A. Marples Ancient Civilisations
ROYAL SOCIETY OF ARTS at 8
EUGENICS SOCIETY (at Royal Society), at 8 30.—Dr C P Blacker Birth Control Research and Practice in Europe.
ROYAL SOCIETY OF MEDICINE (Urology Section), at 8.30 —Prof H Young The Advantages of the Perineal Route in the Treatment of Various Diseases of the Prostate
ELECTROPLATERS AND DEPOSITORS TECHNICAL SOCIETY — Dr W E Patterson Resistance of Electrodeposits to Corrosion, with Special Reference to Cadmium and Zinc

THURSDAY, MAY 1

LINNEAN SOCIETY, at 5 —E B Worthington On the Movements of Plankton in the African Great Lakes —Dr G P Bidder On the Attitude of a Hexactinellid at the Bottom of the Sea, as compared with that assumed in Museum Jars and Monographs —M Burton Glass Sponges.
ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5 —Prof J J R. Macleod Diabetes as a Physiological Problem (Oliver Sharpey Lectures) (2).
ROYAL INSTITUTION OF GREAT BRITAIN, at 5 —Annual Meeting
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—R H Fowler Some Recent Advances in the Electron Theory of Metals (Kelvin Lecture).
CHEMICAL SOCIETY, at 8 — R J W Le Fevre and E E Turner Orientation Effects in the Diphenyl Series. Part VIII The Nitration of 4 4-difluorodiphenyl — Miss D I Fox and E E Turner The Scission of Diaryl Ethers and Related Compounds by Means of Piperidine. Part IV Elimination of Halogen Atoms and Scission Reactions during Substitution Processes
ROYAL SOCIETY OF MEDICINE (Tropical Diseases Section) (Annual General Meeting) at 8
INSTITUTION OF CIVIL ENGINEERS (Birmingham and District Association) (at 6 Corporation Street, Birmingham).—Annual General Meeting

FRIDAY, MAY 2

ROYAL SOCIETY OF MEDICINE (Otology Section) (Annual General Meeting) at 10 30 A.M —Papers by Prof M Bourdillie and G J Jenkins
ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5 —Annual General Meeting
ROYAL SANITARY INSTITUTE (at Town Hall, Tunbridge Wells), at 5 30 — Dr F C Linton and others Discussion on The Maternity Home as a Health Asset —H. T Taylor and others Discussion on Can the Slum be Abolished?
INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7 —C W Marshall The Metering Arrangements for the 'Grid Transmission System in Great Britain (Lecture).
INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7 —Major A. W Farrer Empire Free Trade and the Engineer
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7 —Informal Meeting
GEOLOGISTS ASSOCIATION (at University College), at 7 30 —A A Miller and J S Turner The Lower Carboniferous Succession along the Dent Fault and the Yoredale Beds of the Shap District —R. G S Hudson The Carboniferous of the Craven Reef Belt The Namurian Unconformity at Scaleber Nr Settle.
FARADAY SOCIETY (at Chemical Society), at 8 —Prof G Wiegner On Coagulation (Lecture).
PHILOLOGICAL SOCIETY (at University College), at 8 — Anniversary Meeting
ROYAL SOCIETY OF MEDICINE (Anæsthetics Section) (Annual General Meeting), at 8 30 —Dr R J Clausen Ethylene Anæsthesia.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9 — H. E Wimperis A Study of the Phenomenon of Spin in Airplanes

PUBLIC LECTURES

MONDAY, APRIL 28

FISHMONGERS HALL, E C 4, at 3 —W L Calderwood Modern Views on Salmon Hatching (Buckland Lectures) (1).

TUESDAY, APRIL 29

FISHMONGERS HALL, E C 4, at 3 —W L Calderwood Modern Views on Salmon Hatching (Recent Results from Canada) (Buckland Lectures) (2).
UNIVERSITY COLLEGE, at 5.30 —Dr J C Flugel The Methodology of Happiness
GRESHAM COLLEGE, at 6.—W H Wagstaff Geometry (Succeeding Lectures on April 30, May 1 and 2)

WEDNESDAY, APRIL 30

FISHMONGERS HALL, E C 4 at 3 —W L Calderwood The Sea and River Life of the Salmon (Buckland Lectures) (3).

THURSDAY, MAY 1

ST THOMAS'S HOSPITAL MEDICAL SCHOOL, at 5.30.—Dr H Leslie-Roberts Some Biological Aspects of the Human Skin (Succeeding Lecture on May 2)

FRIDAY, MAY 2.

UNIVERSITY COLLEGE, at 5 — Prof B. Ashmole History of Ancient Sculpture

EXHIBITION

APRIL 28 TO MAY 3.

EXHIBITION OF ROUMANIAN PEASANT ART (under the Auspices of the Royal Anthropological Institute and the Folk Lore Society) (at 52 Upper Bedford Place, W C 1), from 10 30 A M. to 5 30
April 29, at 8 30 —Dr M Gaster Roumanian Art and Handicraft in its Relation to the Balkan Peoples

DISCUSSION

APRIL 25 AND 26

FARADAY SOCIETY (at Chemical Society).—Optical Rotatory Power
Friday April 25, 2 30 to 7 P M —Prof T M Lowry Introductory Paper

(a) The Physical Basis of Optical Rotatory Power

Prof P P Ewald Introduction to Physical Theories of Natural Optical Activity
G Temple Wave Mechanics of Optical Rotation and of Optically Active Molecules
Prof R de Mallemann On Molecular Theory and the Calculation of Natural Rotatory Power
Dr W Kuhn The Physical Significance of Optical Rotatory Power
Dr K Wolf The Principle of the Free Rotation of Optically Active Molecules
Dr H G Rule The Influence of Polar Substituents on the Optical Rotatory Power of Organic Compounds

(b) Apparatus and Methods

Dr R. Descamps Methods for the Measurement of Natural Rotatory Power in the Ultra Violet Region of the Spectrum
Prof T M Lowry and Dr G Owen Note on the Calculation of Dispersion Equations

Saturday, April 26, from 10 A M to 1 15 P M, and 2 30 to 4 P M

(c) Rotatory Power of Solutions

Prof A. Cotton The Existence of Racemic Compounds in Solution and the Application of Circular Dichroism to the Synthesis of Active Compounds.
Prof E Darmois Salt Effect and Rotatory Power
Prof G Bruhat The Absorption and Rotatory Dispersion of Solutions of Tartaric Acid
Dr P C Austin The Rotatory Dispersion of Tartaric Acid and its Derivatives.
Dr R Lucas The Origin of the Variations in the Rotatory Power of a Compound
Prof T S Patterson The General Behaviour of Optically Active Compounds from a Single Point of View
G Owen The Effect of Concentration on the Values of the Dispersion and Rotation Constants for Solutions of Camphor in Methyl Alcohol

(d) The Chemical Aspects of Optical Rotatory Power

Dr W H Mills Molecular Dissymmetry
Prof R Betti Relationship between Rotatory Power and Chemical Constitution
Dr J Kenyon Relation between the Rotatory Powers of the Members of Homologous Series.
Prof J Read Optical Superposition
Dr J Kenyon and Dr H Phillips Some Recent Developments in the Study of the Walden Inversion

ANNUAL MEETING

MAY 1 AND 2

IRON AND STEEL INSTITUTE (at Institution of Civil Engineers).
Thursday, May 1, at 10 A M —Presentation of Bessemer Gold Medals to Dr E Schneider and Dr W Rosenhain
Prof W A Bone L. Reeve, and H L Saunders An Experimental Inquiry into the Interactions of Gases and Ore in the Blast-Furnace Part II Carbon Deposition at 450 C and its Influence upon the Ore Reduction Equilibria between Gases and Ore at 650 to 1000 C
F Bainbridge Developments in Fuel Economy at Skinningrove
At 2 30 —R Whitfield Single Sheet or Thin Pack Normalising, or Heat Treatment *versus* Box Annealing of Sheets
E Mort Tin and Sheet Mill Rolls Their Treatment, Performance, and Premature Failure in Service
Sir H C H Carpenter and J M Robertson The Metallography of some Ancient Egyptian Implements
J A. Jones Chromium Copper Structural Steels.
Friday, May 2, at 10 A M —Announcement of Award of the Andrew Carnegie Research Scholarships for 1930-31 Announcement of Award of the Williams Prize to W E Simons.
Dr W Rosenhain and C H M Jenkins Some Alloys for Use at High Temperatures Nickel-Chromium and Complex Iron-Nickel Chromium Alloys. Part I —C. H. M Jenkins, H J Tapsell, C R. Austin, and W P Rees Part II
J L. Haughton and M L. Becker Alloys of Iron Research Part IX The Constitution of the Alloys of Iron with Silicon
M L Becker Carburising and Graphitising Reactions between Iron-Carbon Alloys, Carbon Monoxide, and Carbon Dioxide
A L. Norbury and E Morgan The Effect of Melting Conditions on the Microstructure and Mechanical Strength of Grey Cast Irons containing Various Amounts of Carbon and Silicon
A. R. Page and J H Partridge The Properties of some Steels containing Chromium
D Brownlie The History of the Cementation Process of Steel Manufacture. Part I —Baron de Laveleye Part II
S. Maita The Corner Ghost in Steel Ingots

SATURDAY, MAY 3, 1930

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British Aviation

THE peaceful penetration of all fields of thought and activity by the spirit and method of scientific inquiry is well illustrated in the extent to which eminent politicians, and ministers of the Crown, now frequently refer to the need for relying on scientific knowledge for our material salvation This is strikingly exemplified in the speech delivered by Mr F Montague, Under Secretary of State for Air, on Mar 18, in presenting the Air Estimates Gone is the old tradition of regarding decimal points as mere 'damned dots' of no importance, and in its place we have the 'new style' speech bristling with technical details that one might expect only from the mouth of the most hard headed expert as a justification to democracy for the expenditure of its hard earned money In a sense this change should occasion no surprise The Air Force is a new wing, and, unlike the Army and the Navy, has no long evolutionary history behind it It is an upstart that has won eminence by a series of scientific and technical strokes It can only be developed by technical knowledge it can scarcely even be conducted without it

The total of last year's estimate was £16,960,000, as against for this year a total of £17,850,000, an increase due in the main to the provision of up to date equipment, essential alike for safety and efficiency, the growing needs of civil aviation, and outlay in scientific research It can scarcely be contended that the air policy of Great Britain is anything but limited and unprovocative If consideration is given to comparative air strength, and to the trend of air expenditure of such powers as France, Italy, and the United States of America, it becomes clear that the Air Force of Great Britain is substantially exceeded in first line strength by these three other powers In this connexion it should be borne in mind that our overseas garrisons, in the Middle East, and in India, make a much greater call than those of other countries On the basis of metropolitan strength our standard is half-power approximately, compared with our nearest neighbour In reply to a question by Sir Samuel Hoare on April 16, the number of aeroplanes maintained by the respective nations, now, and five years ago, were stated to be

	1925	1930
Great Britain	630	780
France	1280	1310
U S A	750	950
Italy	600	1100

The extension of the Air Force is no mere

expansion in the ordinary sense To an increasing degree it is being used in the military field in substitution for ground forces, with a consequent considerable economy No other nation has yet pursued this policy of replacement to the extent to which Great Britain has done The change wrought by this kind of transformation is well illustrated by the case of Aden, where for the last two years there has been an air squadron of twelve machine strength and a total complement of 200 men, in replacement of one British and one Indian battalion of infantry with a total strength of about 16,000 Even as a mere aid to transport the effect of the aeroplane is of no mean order During the Palestine riots the prompt arrival of fifty soldiers by air did much to stem the movement Aircraft were used to drive off attacks by Arabs on isolated Jewish colonies before the arrival of ground reinforcements, in fact, according to Mr Montague, as an instrument for quelling insurgents in almost inaccessible regions of the Far East, the Air Force has been invaluable

The multitude of non military uses to which these aircraft have been put is almost incredible emergency assistance in cases of a medical and surgical character, particularly in India, rescues on British coasts and in the Middle East, warnings of floods in India, survey photography, participation in the anti locust campaign in the Sudan, fishery protection against poaching by foreign vessels on the east coast of Great Britain, co operation in the search for overdue fishing craft after gales These are some of the diverse activities that the Air Force has been called upon to perform Meanwhile, numerous reconnoitring flights are being undertaken across Africa, from north to south, with the object of trying out weather conditions for flying, and to examine the possibility of maintaining prearranged time tables under adverse conditions In one such test flight, aircraft from Cairo, after a journey of 11,200 miles, returned late by five minutes only on the scheduled time

The part of the Under Secretary's speech, however, that dealt with the more purely scientific side could have been understood by only a small fraction of his hearers The Minister explained in detail a large number of the highly technical problems that are being undertaken under the heads of research and development at various research stations He described, for example, the scientific nature of the problem of noise in aircraft, the analysis of its source, how it is measured, and the investigations that are being pursued with the object of reducing it He explained the nature of aerodynamic interference of aeroplane parts, and its effective wastage of horse-power, and he went on to describe in scientific terms the method of air tunnel testing of models, and its limitations as regards scale-effect This enabled him to justify the expenditure on a larger wind-tunnel and a new high pressure tunnel that are being constructed, and to explain their underlying principles Engine research, wireless rotating beacons for direction finding, and many other new scientific developments, also found their place in a remarkable speech

To scientific men in Great Britain it is especially gratifying to realise that their work, in its most technical form, has penetrated into the First Chamber in the land If, however, the House of Commons is to maintain itself, in these difficult circumstances, as a stage for critical and intelligent discussion, it is vital that members of that body who possess a scientific training should meet on common ground It is to be hoped that this may be provided by the new Parliamentary Science Committee

The Platinum Group Metals in South Africa

The Platinum Deposits and Mines of South Africa By Dr Percy A Wagner With a Chapter on the Mineragraphy and Spectrography of the Sulphidic Platinum Ores of the Bushveld Complex, by Prof D H Schneiderhohn Pp xv + 326 + 38 plates (Edinburgh and London Oliver and Boyd, 1929) 21s net

IN this book we have a complete history of the platinum group of metals from their genesis and mineralogy to the mining companies that exploit them Dr Wagner—and one realises with deep regret that this is the last time we shall receive such another work from his hands—speaks with authority, the authority that comes alone from personal experience He also secured the services of Dr Schneiderhohn, who contributes a valuable chapter abounding in admirable photo micrographs on the mineragraphy, spectrography, and genesis of the platinum bearing nickel-pyrrhotite ores of the Bushveld Complex In addition to plates, there are 37 text figures

Production of the platinum group of metals began in South Africa in 1921 when the recovery of 'osmiridium', a concentrate composed of several minerals, was begun in earnest in the Far East Rand The distribution of the 'osmiridium', principally derived from the Main Reef Leader, corresponds very nearly with that of the gold, but

at the best (in Modderfontein 'B') was only 1 oz per 1212 tons of conglomerate milled in 1924 It is entirely a by product to the winning of the gold In the central part of the Transvaal, however, the matter is different, for in 1925 the discoveries in the norite of the Bushveld Complex were made, a rock series which "probably contains in the aggregate more platinum than all the rest of the earth's crust accessible to man" Hence it is with this "vast composite body of plutonic and volcanic rocks" that Dr Wagner's book is for the greater part concerned

In general characters the Bushveld Igneous Complex is well known to students of African geology it is a basin shaped sheet or lopolith, 2 3½ miles thick and wonderfully differentiated into sheets and lenses simulating stratification Of these layers, the Merensky horizon, most important in the Rustenburg district, claims a large section of the book, which is dedicated with an obvious regard to its discoverer The Merensky Horizon contains the Merensky Reef', a pseudo-porphyritic pyroxenitic diallage norite, occasionally "almost uncanny" in the regularity of its dip and strike In many places 'chrome bands' are important features of the horizon This occupies six chapters, and it is impossible to sum up in brief space the immense amount of detail with which these are crowded It deserves six chapters, since Dr Wagner concludes its deposits are "among the world's greatest concentrations of mineral wealth"

Dr Schneiderhöhn's contribution to our knowledge of the nickel pyrrhotite ores is also very detailed The elaboration of the research is shown by the method employed It was found that microscopic work failed and ordinary analytical procedure proved impracticable to ascertain which minerals contained platinum and to what extent Accordingly, isolation of individual grains was effected by means of a motor driven drill resembling that used by dentists and minute fragments bored out under the microscope These were then vaporised in an arc lamp and the ultra violet part of the spectrum obtained by the use of a quartz spectrograph It was found that the chalcopyrite (the last sulphide to be formed) and millerite contained no platinum, which was present in the nickeliferous pyrite, pyrrhotite and pentlandite, these also containing cobalt Other results of interest are recorded, for which the reader is referred to the book

A short chapter is devoted to the Great Dyke of Southern Rhodesia, and it is thought that the small quantity of platinum and associated pebbles of chromitite of the Somabula field near Gwelo were derived from it In a few pages the seemingly disappointing nickel copper occurrences in the gabbro norite (a phase of the Karroo dolerites) of Insizwa and Tabankulu, and the more unusual ones of the Waterberg district in the central Transvaal, are described In the latter, the metal is found in quartz lodes along faults which cut felsites and tuffs of the Bushveld Complex, and is remarkable for its extremely erratic distribution, some assays giving extraordinarily high figures, "probably the highest" ever known

The book concludes with short accounts of mining methods and mining companies, marketing conditions, and costs of production, among which one notes that to produce 1 oz of platinum from the rocks of the Merensky Horizon costs about £6 the average content is roughly 5 dwt per short ton

It is somewhat surprising to read that approximately 70 per cent of the world's total platinum supply is used for jewellery, whereas before the War it was employed for technical purposes For the latter, substitutes have now been found

This is a book for geologists and mining engineers alike, and will doubtless remain for long the standard work on its subject

JOHN PARKINSON

Political Science

Research in the Social Sciences its Fundamental Methods and Objectives By Robert Ezra Park, Allyn Abbott Young, Clark Wissler, Robert Emmet Chaddock, Robert Sessions Woodworth, Roscoe Pound, Arthur Meier Schlesinger, John Dewey, Charles Austin Beard Edited, with an Introduction, by Wilson Gee Pp xi + 305 (New York The Macmillan Co, 1929) 8s 6d net

THIS book is a series of more or less authoritative essays on the several branches of social science and exhibits wide variation in merit, ranging from vague meandering through wordy labyrinths leading nowhere, up to real sublimity and noonday clearness of thought A sample of the labyrinthic uncertainty meets us at the very outset in the first essay, wherein Teggart is said to have stated the difference between history and the other sciences in one "fine phrase" He said "Science deals with objects, entities, things, and their relations, history concerns itself with events" One could, of course, debate until doomsday on such

a theorem, either for or against, without tolerable approach to a satisfactory, definite, and agreed solution No very clear light is thrown on the matter by the further cryptic utterance "Events happen, things do not" Hence we may conclude that science deals with things that do not happen! All this may be fine phraseology, but does not appear very helpful to the hopeful student struggling to make his way over the wide and troubled seas of sociology Moreover, the above quotation from Teggart is supposed to note the difference between history and the "other sciences", and this would seem to imply that history itself is a science Whence it follows that one particular science, history, deals with events that happen, whilst the other sciences treat of things that do not happen! Let us find what solace we can in this methodological labyrinth

Is history a science? Taking one wild leap over all the intervening essays on economics, anthropology, statistics, psychology, jurisprudence, history, and philosophy, we come to the last one, on political science, by far the best of the whole series, both in vigour and clearness of thought and in helpful and stimulating suggestiveness Alighting breathless after a long jump, the above query greets us Prof Charles Austin Beard says

> "Ever since Newton discovered the law under which the stars swing in their orbits imaginative thinkers have toyed with the possibility of reducing history to a science, and thus, automatically, the scattered and disjointed operations of mankind grouped for convenience under the head of politics"

Many great thinkers and the scientific spirit of the modern age have fed this ambition Henry Adams said that every professor who has tried to teach the doubtful facts we now call history must have felt that, sooner or later, he or another would put order in chaos and bring light into darkness Does it really matter very much? It all turns on our definition of science, and we have had to abandon every attempt to be very precise or inelastic in any definitions anywhere Whether or no we can bring history and therefore politics within the orbit of true science, there must always be a vast borderland where one hovers between science and no science or between science and philosophy, a region that must be closely scrutinised by all men

Prof Beard very ably discusses some of the difficulties in the path of recognising political science as such These seem to consist mainly in the first place in unsuitable materials to work on, and secondly in biased minds to work with Looking back over the political literature of the past two hundred years, he thinks that the major part of it, even of the greatest writers, is conspicuously partisan in spirit, designed to defend some existing political order or to discredit it in the name of something that is thought to be better, and "if such be the state of our literature, what can be said of the state of our minds", a confused mix up of convictions, prejudices, kinks, predilections, hunches, grouches The first difficulty is probably contained in or a corollary to the second, and the defective mind has presided over all the works of the greatest political thinkers at least for the past two hundred years Possibly, if we could glance backward two thousand four hundred years instead of only two hundred, and thus include Aristotle, we might luckily find at least one mind capable of rising above narrowness and prejudice But, taking the lesser sweep of backward vision, is it really the fact that all our writers and political orators within that period have suffered from these mental infirmities? Must we thus stigmatise such men as Burke, Chatham, Milton, or John Locke? Perhaps they have not been strictly scientific in the sense in which we understand the term to day, they have at all events been above or in advance of the general level of political thinking in their time, they have exhibited in a high degree political wisdom and sagacity, though whether this is the same thing as political science we need not stay here to inquire, and they have made wonderful contributions to the practical task of building up that noble edifice, the British constitution, and in enunciating the principles of sound government

Prof Beard admits that these real or imaginary defects, both in the materials requisite for constructing a science of politics and in the mental equipment available for the purpose, are not peculiar to the political and social sciences, they have been met with in the purest of the physical sciences, and do not necessarily and completely inhibit the ultimate hope of achieving a true science of politics, if we really are desperately anxious to make politics scientific in form and spirit A more serious difficulty, according to the author, is the utter futility of such a science, that is, if it is to attain to any sort of capacity for prediction, able to trace the trajectory of future political events Could, for example, political happenings have been safely predicted in any university in Germany in regard to the period 1910–20, without placing the professors under imminent risk of being

stoned or burnt by an enraged populace? Also that which is plotted in the curve would be inexorable "If we could get enough knowledge to make a science of politics, we should imprison ourselves in an iron web of our own making" We could not by any effort prevent or change anything in the prognosis

Waiving the question whether such inexorable predictability is a necessary quality of genuine science, must we cease our search for sufficient knowledge to make a science of politics for fear that we should thus be self condemned to feverish arachnidal activity and become hopelessly enmeshed in iron webs? Reasoning on the analogy of astronomy, one could easily reach a *reductio ad absurdum* Astronomical eclipses are predictable and inexorable, but we do not call such knowledge useless or set it up as an argument against the admission of astronomy to the realm of science In the political sphere, where phenomena are much more under human control, especially in view of the tremendous powers now placed in the hands of modern governments, it does not seem that prognosis, if attainable, need always be inexorable, or at least, if we could not change coming events we could possibly in some measure provide for or against them, or even introduce modifying factors

The kernel, however, of Prof Beard's essay is much more important and less controversial than these preliminary excursions He maintains very justly that what is really needed to day is creative thinking in the political sphere, and it is immaterial whether the results of such thinking are called political science, theory, philosophy, descriptive politics, or merely political thought We very urgently need intelligence applied to political data, and the main questions are What is intelligence? How can it be developed and enriched? What are the conditions favourable to its exercise on the data of politics? We are treated to a brilliant disquisition on the subject of intelligence in which the so called American intelligence tests are reduced to absurdity, and even the President of the United States is severely handled and called upon to explain himself President Hoover had recently ventured to include the following very innocent-looking little contribution to political science in an address to the engineering profession

"The engineers have contributed a great purpose in the United States—a purpose that is applicable to all branches of public life, not only their service but the engineers' mode of thinking by which there must be determination of exact facts, followed by a proper presentation of these facts in their proportional weight before any determination is made of either public or private issue That should be the basis of government action"

This might well pass as a general description of scientific method, but Prof Beard finds it bristling with difficulties when applied to politics, questions the terminological precision of nearly every word, and pulverises the whole statement with a heavy barrage of dictionary references

No, there is no science of politics, and there is not much room even for the application of scientific method It remains to consider the most favourable conditions for that hard creative thinking which seems to be the only thing left to us Among these leisure and freedom are of primary importance though not always essential, and they do not necessarily induce thought The intellectual atmosphere of the universities is not always favourable and might well be improved in various ways

"There are in the university too many charming friends who must not be offended, too many temporal negotiations that call for discreet management, too many lectures to be delivered, too many promotions requiring emphasis on the amenities of life rather than on its thinking processes, too many alumni eager to apply in 1928 what they learned in 1888, too much routine, not enough peace, too much calm, not enough passion, above all too many sacred traditions that must be conserved, too many theories, not enough theory, too many books, not enough strife of experience, too many students, not enough seekers Yet with all its handicaps to thought the university must supply the training for most of our political thinkers, and with all its limitations it furnishes the most favourable climate for creative work in America"

Practical experience with government as a going concern is desirable if it can be combined with aloofness from its immediately practical ends and freedom from financial or commercial entanglements or other interests One may add as a final stimulant to creative political thinking a clear apprehension of the goal aimed at and of some of the problems which call now for urgent solution Prof Beard propounds several of these, and his list is remarkable in the height and depth of its range If, as Edmund Burke said in regard to the conciliation of the American colonies, the mere attempt would be an undertaking that would ennoble the flights of the highest genius, so the mere contemplation of some of these momentous problems, on which depends the destiny of mankind, may well stir the mind and imagination to the supremest exercise of thought—the first essential in any effective action W G LINN CASS

The Sea and all that in it is

The Seas our Knowledge of Life in the Sea and how it is Gained By Dr F S Russell and Dr C M Yonge Pp xiii + 379 + 127 plates (London and New York Frederick Warne and Co, Ltd, 1928) 12s 6d net

THIS handy volume, comprehensive and competent, illustrated generously and luminously, is easily the best of the smaller books dealing with the sea and all that in it is The only English book that can hold a candle to it is Sir John Murray's little volume in the Home University Library, but it is much smaller and necessarily restricted in its illustrations With larger treatises, the best of which is "The Depths of the Ocean" by Murray and Hjort, the present compact volume does not compete, but the gist of the matter is all here, and the whole story of oceanography is admirably told

We congratulate Dr Russell and Dr Yonge on a first class piece of work, neither too popular nor too technical, a book of wide vistas, illumined with biological ideas It is written *con amore*, and we find the freshness and sparkle of the sea in its pages It is one of the most successful of recent ecological books, not only in its grip and clearness, but also because it is written educatively, building up from the familiar to the extraordinary, and from the general to the detailed, yet all as if the authors were thoroughly enjoying themselves, as their readers certainly do

After a general introduction on man's intellectual struggle with the problems of oceanography, "The Seas" starts with the life of the shore, the depths, and the open waters There are chapters on the swimming animals and the drifting animals, while the strange byway followed by borers is separately discussed Coral reefs prove as fascinating as ever, and then comes a fine chapter on colour and phosphorescence A discussion of different modes of nutrition among marine animals is followed by chapters on sea water and on the oceanic changes that are correlated with the seasons The authors pass on to methods of oceanographical research, and then come several predominantly practical chapters devoted to fisheries, shellfish industry, fishery research, and the diverse products of the sea Great restraint is shown throughout, for many of these subjects are very apt to run away with their expositors

It is difficult not to be extravagant in praising the well selected illustrations, many of which, including the coloured plates, are due to Mr W J Stokoe, who displays brilliant skill It is not only that the illustrations are beautiful and fresh, we wish especially to praise their educativeness They do not merely adorn the tale, they continue it The altogether admirable volume, which we wish to recommend unreservedly to all interested in the sea, is appropriately dedicated to Dr E J Allen of Plymouth, the inspirer of so many investigations in marine biology

Our Bookshelf

Die Rohstoffe des Tierreichs Herausgegeben von Ferdinand Pax und Walther Arndt Lieferung 2 Pp 161 400 18 gold marks Lieferung 3 Pp 160 12 gold marks (Berlin Gebrüder Borntraeger, 1929)

THE second part of this interesting work is composed of five chapters The first chapter is devoted to a consideration of the shells of molluscs as ornaments, amulets, as material for the preparation of cameos, as money, trumpets, lamps, etc The second chapter deals with the electrical deposition of metals on the exterior of animals such as snakes, the sea horse (*Hippocampus*), etc, by which successful permanent preparations are possible, and in an appendix the method of impregnating similar animals with paraffin wax in order to obtain dry preparations for museum purposes is briefly described The following chapter is on animal substances employed in powdered form as grinding or polishing materials, as tooth powder (for example, cuttle bone), and on skins, such as those of fishes used in smoothing and polishing ivory and other materials The chapter on insect galls describes the principal kinds of galls found in commerce, with analyses of the more important

The final chapter of this part is on colouring matters of animal origin, especially cochineal and the purple from the hypobranchial gland of certain molluscs An account is given of the history of these purple dyes, the constitution of one of which was determined by Friedlander, who prepared from 12,000 specimens of *Murex brandaris*, collected at Trieste, 1 4 gm of the purple dye and showed it to be a brominated indigo (dibromindigo) An adequate account is added of the production, preparation, and nature of sepia

The third part of this work is concerned entirely with the formation, extraction, qualities, and uses of the numerous forms of fat, oil, and wax, and of shellac Details are given of melting points and other physical properties and of the chemical constitution of many of these substances, and reference is made to the more usual adulterants and to the methods by which their presence may be ascertained

Of most of the substances dealt with in these two parts, there is an adequate historical account as well as particulars of the amounts of many of them exported or sold in given years, and the areas principally concerned in their preparation and in their use At the end of each section is a helpful bibliography

The Atom By Prof G P Thomson (The Home University Library of Modern Knowledge) Pp 252 (London Thornton Butterworth, Ltd, 1930) 2s 6d net

THE needs of the general scientific worker and the scientifically minded layman wishing to acquire a general knowledge of the advances and spirit of contemporary physics are very fittingly met by Prof G P Thomson's admirable little work The author has, in a short compass, presented an up-to date survey of physical theory and its bearing on chemistry with an extensiveness which would not be suspected from the title Starting with the spectrum and not forgetting cosmic rays, the reader is led through the fundamental laws of chemistry to the electron, isotopes, positive-ray analysis, crystal structure, and radioactivity to energy units, the conception of the quantum, and its development on the older theory

The most interesting part of the book is, however, that devoted to the recent wave theory of de Broglie, its development by Schrodinger, and the ideas underlying the electron wave The clear logical treatment throughout is assisted by a variety of happily chosen analogies A surprising number of topics come under notice, the reader will not look in vain for reference, necessarily superficial, to Heisenberg's uncertainty relation, Pauli's principle, the work of Davisson and Germer on the electron wave, Dirac and Darwin's work on the spinning electron, and Eddington's recent treatment of $hc/2\pi e^2$ The modifications of the older Bohr orbit scheme necessitated by the wave mechanics are explained, and the rôle of the electron in chemical theory is interpreted The book concludes with some considerations on the philosophical aspect of modern physics

Mathematics has been entirely avoided, the author confining himself mainly to those concepts which lend themselves to physical interpretation Due prominence is given to the fundamental part played by probability The reader will not appreciate the co ordination and development of Heisenberg's matrix mechanics and Dirac's analysis with the wave mechanics, these being unsuited to verbal explanation are wisely omitted The possibly one-sided view resulting is largely offset by the clarity of the wave picture A difficult task has been accomplished in a manner which will repay the study not only of the non specialist but also of the general scientific worker who has no wish to be lost in a mathematical fog N M BLIGH

The Year Book of the Scientific and Learned Societies of Great Britain and Ireland a Record of the Work done in Science, Literature and Art during the Session 1928–1929 by numerous Societies and Government Institutions Compiled from Official Sources Forty sixth annual issue Pp vii + 413 (London Charles Griffin and Co, Ltd, 1930) 18s net

Is this to be the last issue of this useful annual? Unless further support is received the publishers announce that they cannot continue its publication, at least in its present form, and it is proposed to economise by printing only the titles of papers which have been published as well as read We doubt, however, if this would enable the publishers to reduce the price of the volume substantially and in these days of heavy expenses it is the high price which, we believe, prevents a wider sale If the "Year Book" as it is cannot continue, we would suggest an annual volume omitting all the lists of papers Such a classified directory giving the names and addresses of learned societies and including, as now, their officers, brief particulars as to meetings, publications, and conditions of membership, would be useful and the information could be kept thoroughly up to date if the volume was issued about May For the present, however, we must be grateful to the publishers for continuing their efforts and also to the officers of societies who have given the time and trouble to enable the "Year Book" to retain its official character

Joy in Work By Henri de Man Translated from the German by Eden and Cedar Paul Pp 224 (London George Allen and Unwin, Ltd, 1929) 8s 6d net

THE English title is to be preferred to the original German, "Der Kampf um die Arbeitsfreude", for joy in work is spontaneous, not the result of struggle An interesting thesis is somewhat marred by extravagant phrasing, insensibly we think of "the devil rebuking sin" when the author inveighs against German books where "the old grist is reground into a new and jawbreaking terminology", let the following from "Joy in Work" suffice— "certain kindred antinomies in proletarian characterology", which doubtless well expresses the Teutonic original The subject is treated under the aspects of "Impulse" and "Hindrances" to such joy, and it is based on reports from workers, in response to a questionnaire furnished by the author He discusses medieval craftsmanship and modern mechanised labour, the merits and demerits of payment by time and by results, and distinguishes the factors that influence Teutonic psychosis from those that affect the Anglo Saxon races He wisely remarks that "payment by the piece need only endanger the quality of the product when piecework rates and minimum wages are so low that the worker has to speed up immoderately in order to earn a subsistence", and suggests that the owner's profits should "increase only in proportion to the increase in the workers' wages" P L M

Gmelins Handbuch der anorganischen Chemie Achte Auflage Herausgegeben von der Deutschen Chemischen Gesellschaft *System Nummer 59 Eisen* Teil A, Lieferung 1 Pp 224 (Berlin Verlag Chemie G m b H, 1929) 33 gold marks

THE section of Gmelin's 'Handbuch' dealing with iron (Part *A*) is an ambitious work to which eight specialists have promised to contribute The 224 pages now issued include a remarkable historical bibliography covering 59 pages, with nearly 2000 references, about 120 pages on the occurrence of iron, and in conclusion some 40 pages on the preparation of pure iron in various forms

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

Age of the Earth

I HAVE just finished reading a most interesting book on "The Universe Around Us", by Sir James Jeans It opens up a complex and abstruse subject with admirable clearness, so that even a geologist possessed of very little mathematics can find his way through it without too much difficulty The ease with which in this brilliant book millions of millions of stars are marshalled and their history outlined for millions of millions of years inspires no little awe and a large amount of envy in the breast of a plodding geologist who keeps to the solid earth If the book contained only the inspiring visions of an astronomer in regard to the origin and the fate of the universe around us a geologist might refrain from comment, but at several points the history of the earth and its inhabitants is touched upon, giving him a right to a word of criticism

Sir James in a page or two suggests that the earth began about 2,000,000,000 years ago as a globe of intensely hot gas, which gradually cooled down, becoming first a liquid, then plastic, and finally an outer crust solidified, "rocks and mountains forming a permanent record of the irregularities of its earlier plastic form" Life probably began on the earth about 300,000,000 years before the present

A generation ago, when Lord Kelvin laid down the law as to geological time, this allowance would have seemed very liberal, but the discovery that the age of certain rocks can be determined by an analysis of the radioactive minerals they contain has completely changed our point of view 2,000,000,000 years is decidedly too short a time for Pre Cambrian history if the earth began in a gaseous form, and life existed far earlier than 300,000,000 years ago

These points are easily proved by a brief study of the Grenville Series of Ontario and Quebec and of the Laurentian granite and gneiss which have erupted through it, since radioactive minerals are found in pegmatite dikes connected with the granite

AGES OF PEGMATITE IN ONTARIO AND QUEBEC

Localities	Determined by T L Walker [1]	Determined by H V Ellsworth [2]
Parry Sound	1,274,000,000 years	1,179,000,000 years
Villeneuve	1,293,000,000 ,,	1,189,000,000 ,,
Cardiff Tp	1,239,000,000 ,,	1,299,000,000 ,,
Butt Tp		1,130,000,000 ,,

The localities are scattered over 200 miles from west to east, and it will be observed that the age of the pegmatites does not differ greatly at the various points and that the two analysts are not far apart in their determinations We may conclude that the uraninites of the pegmatites were formed about 1,230,000,000 years ago

The pegmatite dikes are the latest phases of the molten granite which heaved up the rocks of the Grenville Series into domes forming important mountain chains which covered many thousand square miles, and the Grenville Series must have been solid rock long before this took place

The Grenville rocks are now crystalline limestones, gneisses, and quartzites, but were originally ordinary limestones, shales, and sandstones, which were deposited as limy material, mud, and sand in a shallow sea

The series is very thick according to Dr Adams, who measured 17,824 feet in one section and 94,406 feet in another, and to the age shown by the radioactive minerals must be added many millions of years for the deposit of a great geological formation, its consolidation, and the thrusting up of the widespread Laurentian mountains

But we are still far from the beginning Before the Grenville sediments could be laid down the earth's crust must have been firm and solid to form shores and sea bottoms of a permanent kind, and must have been cool enough to allow rain to fall and rivers to bring down mud and sand into the sea If the earth ever passed through a stage of heat and plasticity, that was completely over before the beginning of the Grenville sea, and the water was cool enough to allow algæ or other lowly plants to thrive, since in places the sediments contain several per cent of carbon, now in the form of graphite

Life had already appeared in the sea

The Grenville rocks have been chosen for this study because they are well known and are dated by analyses of radioactive minerals, but they are probably some what surpassed in age by the Keewatin, which is mainly volcanic, but with important amounts of sediments, and the Coutchiching, which is wholly sedimentary No uraninites have yet been found in the granites which penetrate them

Taking all of these formations together, we have a known area of 1,000,000 square miles of cold and rigid rocks with well established lands and seas in North America 1,300,000,000 or 1,500,000,000 years ago, with no suggestion of physical conditions fundamentally different from the present

The oldest rocks in Brazil, South Africa, Australia, India, Scandinavia, and Scotland, judging from what I have seen of them, include similar sediments to those of the Grenville and Keewatin in Canada, though not on so broad a scale In Holmes's interesting discussion of the "Age of the Earth", the Lower Pre Cambrian of West Australia is stated to be 1,260,000,000 years old, which fits well with the age of the Grenville

There were, then, solid land surfaces not too warm for lakes or seas to exist in all the continents in the earliest times known to the geologist, and there is, in fact, no geological evidence that the world ever was molten If our globe passed through intensely hot gaseous, liquid, and plastic stages, the cooling had run its course completely many millions of years before the pegmatite veins penetrated the Grenville sediments, and the cold continents had undergone at least one major mountain building revolution at an earlier time than 1,230,000,000 years ago

Since then the earth has not been cooling down, but has kept its surface temperature surprisingly uniform, though with minor variations, including several ice ages The carbon and limestone in the earliest rocks suggest lowly plant life in the waters from the very beginning of known geological history, and the Pre-Cambrian geologist is inclined to be a uniformitarian, and to ask the astronomer if the first quarter of the world's history was really so wild and turbulent as he describes it, when the later three quarters were so temperate and uniform

May not the earth have been built up of cold particles such as now reach us by the million from space, and may it not have escaped entirely the white hot stage of the nebular theory? Is it not possible that the hot gases cooled rapidly into innumerable solid particles which later came together to make the earth? The tiny scattered asteroids and meteorites suggest some such process, and this would provide

the cold earth which the Pre Cambrian geologist requires

If the astronomers cannot provide a cold process of world building, they must allow the geologist a much longer time than 2,000,000,000 years to condense the hot cloud of gas into a solid world with continents and basins cool enough for the Grenville sea with its algæ

A P COLEMAN

Royal Ontario Museum,
Toronto

[1] Ages of Some Canadian Pegmatites *Contribs to Can Mineralogy* Univ, Toronto, 1924

[2] Radioactive Minerals as Geological Age Indicators *American Journal of Science* No 50 p 127, etc

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Recombination of Electrons and Positive Ions in the Upper Atmosphere

A METHOD of obtaining the recombination co efficient of the electrons and ions in the upper atmosphere can be arrived at by the use of some recent radio telegraphic observations The method depends essentially upon the measurement by radio methods of the maximum density of electrons in the layer at various times of the night after the ionising agent, the sun's ultra violet light, has been removed

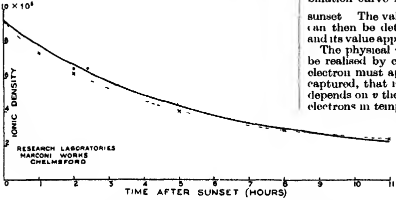

FIG 1 —Full line observed curve, broken line, recombination curve

A ray of frequency ν sent out by a radio transmitter at an angle of elevation θ will not be bent back to the earth again unless there are sufficient free electrons in the layer, and the relation determining the number of electrons N required is

$$\cos\theta = \frac{R+h}{R}\sqrt{1-\frac{Ne^2c^2}{\pi m\nu^2}}$$

N is electron density, when h, the height of the layer is small compared with R, the earth's radius, this is approximately

$$\frac{Ne^2c^2}{\pi m} = \sin^2\theta + 2x,$$

where $x = h/R$, and where e, m, and c have their usual significance

In general, if such a frequency ν is chosen that $\frac{N_{max.}e^2c^2}{\pi m\nu^2} = \delta < 1$, then those rays for which $\sin^2\theta > \delta - 2x$ will not be returned to earth

The method, then, consists in determining the value of θ_{max}, that is, the greatest angle at which rays are reflected to earth For this purpose an accurate determination of θ is necessary The working of the facsimile device between New York and England on a wave length of 22 m has provided an opportunity of accurate measurement of these ray angles

If a single short impulse $< \frac{1}{1000}$ sec duration is sent out by the transmitter, it is generally reproduced as 2, 3, 4, or even 5 separate images corresponding to various rays of elevation at the receiving end θ_1, θ_2, θ_3, θ_4, θ_5, etc From the speed of the receiving drum it is easy to calculate the time intervals T_{1n} between these signals and using the relation

$$T_{1n} = \frac{d}{c}\left(\frac{1}{\cos\theta_n} - \frac{1}{\cos\theta_1}\right) = \frac{d}{c}\left(\frac{1}{\cos\theta_n} - 1\right),$$

where d is the distance of transmitter from receiver (assuming $\cos\theta_1 = 1$), to calculate accurately the value of θ_n

Values of θ up to 35° have been obtained and the value of θ_{max} was found to decrease throughout the night Using this material, the accompanying curve (Fig 1) representing N_{max} as a function of the time after sunset has been secured It is confirmed less accurately by transmission results which give the shortest wave that will return to earth at any given time of the night, and represents therefore the variation of N throughout the night

The dotted line represents the theoretical recombination curve $N = \frac{N_0}{1 + N_0 at}$ where t is the time after sunset The value of a, the recombination coefficient, can then be determined from the best fitting curve, and its value appears to be close to $8\ 75 \times 10^{-11}$ cm ^{3}/sec

The physical significance of this quantity can best be realised by calculating the distance to which the electron must approach a positive ion in order to be captured, that is the 'recombination radius' This depends on v the electron velocity If we assume the electrons in temperature equilibrium at 300° absolute, $v = 1\ 1 \times 10^7$ cm/sec and σ the recombination radius is $1\ 4 \times 10^{-9}$ cm If the actual value of v were v_0 and not $1\ 1 \times 10^7$, the value of a would be $1\ 4 \times 10^{-9}\sqrt{\frac{1\ 1 \times 10^7}{v_0}}$ cm, $\sigma = 1\ 4 \times 10^{-9}/\sqrt{28V}$, where V is the voltage equivalent of the electrons of velocity v This seems a reasonable value in view of the theoretical work of Kramers, Eddington, Milne, and others [1]

Unfortunately, only recombination radii for stripped nuclei can be obtained theoretically from Kramers' formulæ, namely,

$$\sigma^2 = \frac{10^{-20}}{V}\,\frac{Z^4}{r^3(9\ 5z^2/r^2 + 0\ 7V)},$$

where Z is the atomic number, V is the equivalent voltage of the recombining electron, and r the number of the quantum state in which the electron is captured No reasonable adjustment of V can make this formula agree for the ionised hydrogen atom, and the least value of Z required is 7, $r = 1$, in which case σ is $1\ 22 \times 10^{-8}$

The pressure at the measured 'equivalent height' at which the observed recombination occurs, namely, 340 km, is entirely unknown, but certain results, independent of this pressure, may be given

The mean free life of an electron between ionisation and capture is approximately five hours Assuming $v = 1\ 1 \times 10^7$, then the total distance travelled in this time is 2×10^8 km although its final distance from the origin is much less, of course, depending on the number of collisions made with other molecules

During this period it makes about 120 collisions with ionised atoms within a radius of $2\ 74 \times 10^8$ cm (the assumed average radius of the atoms of the atmo

sphere) These last figures depend on the assumed value of v

T L Eckersley

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[1] A summary of the work on recombination is given by Seeliger, Die Wiedervereinigung von positiven Ionen *Phys Zeits*, 30, 1929

Freshwater Biological Research in the Indian Empire.

I have read with deep interest the article by Prof F E Fritsch under the title of "Research in Freshwater Biology and the Functions of a Freshwater Biological Station", published in Nature of Feb 15 (vol 125, p 241) Work in this line is imperative in the Indian Empire Algological research in the Indian Empire is still in its infancy Investigation into the algal flora of this country is not only valuable for its purely scientific interest but also from a practical point of view, as hinted in Prof Fritsch's article So far as my experience goes, this land is very rich in algal vegetation From a few bottles of algæ collected from the Loktak Lake, Manipur, Assam, by the late Dr N Annandale, Dr Bruhl[1] and I have discovered as many as forty three new species of algæ Most of them were found from a small bottle In my recent work[2] on freshwater algæ of Malayan waters, I have described four species and five new varieties which appear new to science Previous works on the algal flora of this country such as those of Turner,[3] West,[4] and N Carter[5] also confirm the prospect of a similar finding of interesting new plants and forms peculiar to the Indian soil and climate

Not much work from the point of view of periodicity, quantitative analysis or ecological study has yet been done here except Fritsch's important publication on "A General Consideration of the Sub aerial Algal Flora of Ceylon and a Contribution to the Study of Tropical Algal Ecology Part I Sub aerial Algæ and Algæ of the Inland Freshwater" Recently, however, I have taken up work on the biological investigation of the filter beds of Calcutta—in collaboration with Rai Bahadur Dr G C Chatterjee (protozoologist), Dr T K Ghose (chemist), and Mr K N Das (zoologist) The work, so far as results obtained up to now show, is of immense importance from a biological point of view as suggested by Prof Fritsch It has been observed that there is a regular rotation in the growth of algal vegetation in the filter beds, which is invariably associated with animal organisms, such as Protozoa, sponges, worms, larvæ of insects and molluscs sp Growth of green algæ predominates over the blue green ones, and diatoms are found either as pure formation or as epiphytes *Synedra affinis* var *fasciculata* is the most common species present in all the filter beds Of the algæ, *Clathrocystis aeruginosa*, *Volvox globator*, *Cladophora crispata* var *genuina*, *Zygnema* sp, *Tribonema bombycinum*, *Gloeotrichia natans*, *Hydrodictyon* sp often grow either as pure or mixed formation or by rotation, one appearing after the other These grow frequently in such huge masses that they have to be scraped off and carried away in cartloads

The life histories of these algæ are intimately connected with and thus controlled by the physical, chemical, and climatic conditions in and around the filter beds Detailed algological and chemical analyses of this water of the filter beds are being carried on, and the correlation of all the factors will, it is expected, throw much light on the aquatic biology of the filter beds Experiments for the control of the different species have been undertaken with the view of keeping the filter beds to a certain extent free from the crowded growth of algal vegetation, as the growth of the algæ sometimes reaches the point when it chokes up the action of filtration Then the masses of algal vegetation, by dislodging from the bottom, cause fissures in the floors of the filter beds which become the abode of animal organisms and thus the filter beds are rendered defective Algal contents of the oysters of the Malay Peninsula are also being investigated

There is, therefore, a vast field for research work in various avenues for the algologists in India There is no doubt that biological investigations of fresh and marine waters of this country are of greatest importance from the points of view of pisciculture and sanitation, for fish, one of the important foods for human beings, are directly or indirectly dependent on algal vegetation, and some lower members of algæ also by assimilation of organic matters for their growth expedite the self-purificatory action of the water

K Biswas

The Herbarium,
Royal Botanic Garden,
Calcutta, Mar 20

[1] Brühl, P, and Biswas, K Algæ of Loktak Lake, *Memoirs of the Asiatic Society of Bengal* No 5, 1926

[2] Biswas K IV Papers on Malayan Aquatic Biology 11 Freshwater Algæ *Jour of the Federated Malay States Museums*, vol 14, pp 404 435, pts 3 and 4 1929

[3] Turner W B Freshwater Algæ of East India, *Kungl Sv Vet Ak Handl* 25, 1893

[4] West and West G S Freshwater Algæ from Burma, including a few from Bengal and Madras *Ann Roy Bot Garden Calcutta*, 1907

[5] Carter, Nellie Freshwater Algæ from India, *Records of the Botanical Survey of India*, vol 9, No 4 1926

The Acquired Characters of *Alytes*

I am glad to see from Dr Walker's letter in Nature of April 12, p 562, that he does not dispute Kammerer's work He is fully justified in doing so since the visit of Kammerer's teacher, Prof Przibram, to London last year, because Kammerer's work was carried out under Prof Przibram's supervision and Prof Przibram, who stayed with me, assured me that the work was sound and that he himself had seen the modified *Alytes* when alive

But Dr Walker asserts that the work, if fully confirmed, would afford no proof of the inheritance of acquired characters because the modified *Alytes*, if replaced in the normal conditions, would in all probability revert to the type form This assertion implies a confusion of thought in Dr Walker's mind, which is shared apparently by many others

It is no explanation of Kammerer's results to say that they are due to "the presence in the germ plasm of potentialities to respond in a definite manner to changes in the environment" Undoubtedly this power resides not only in *Alytes*, but also in greater or less degree in all organisms—otherwise there would be no possibility of evolution The question at issue is whether the exercise of this power in one generation affects the possibility of its exercise in subsequent generations—and Kammerer's experiments not only on *Alytes* but also on *Salamandra* prove in the clearest manner that this is so Dr Walker apparently expects that if an animal, moved from environment A to environment B, responds by a change in growth and structure, this change should persist without alteration when it is moved back from environment B to environment A What we might reasonably expect, and what as a matter of fact we find, is that when the animal is kept for several generations in environment B, the response is intensified and appears earlier in development—in a word, that it becomes more *engrained* in the hereditary complex, and that when it is moved from environment B to environment A,

there is a *lag* in the re-assumption of ancestral characters.

It required, according to Kammerer, no less than six generations in the modified environment to awaken in *Alytes* the ancestral potency to produce the nuptial pad; and the offspring of *Salamandra maculosa*, which had been reared in a yellow environment, became yellower for the first eighteen months of their lives in spite of the fact that they were reared in a black environment. Similar results were obtained by Durkhen with the pupæ of white butterflies, and the cumulative effect of succeeding generations in intensifying acquired immunity has been beautifully shown by Metalnikoff in the caterpillars of the bees-wax moth *Galleria*.

In conclusion, let me describe a series of experiments carried out in my own laboratory at the Imperial College of Science under my supervision by my former colleague Dr. (now Prof.) Hogben. We had specimens of two very similar newts living in our tanks, namely, the axolotl (*Siredon pisciformis*) and the mud puppy (*Necturus lateralis*). Both normally live all their lives in water and retain external gills and open gill slits through life. Both were fed in the same way with thyroid, and the miracle of the change in a few weeks of the axolotl into a small black land newt was enacted before our eyes. But no amount of thyroid feeding made the smallest change in the appearance of the mud puppy. In one case the power to metamorphose into a land newt, though overlaid by the new perennibranchiate character, still survived as a 'suppressed complex'; in the other, owing to the deeper engraining of the perennibranchiate character, it had apparently been irretrievably lost.

E. W. MACBRIDE.

Imperial College of Science,
London, S.W.7.

Adsorption on the Crystal Lattice of Cellulose.

INVESTIGATIONS into the adsorption of various substances by cellulose in the presence of dispersive mediums such as sulphuric acid, zinc chloride solution, etc., have resulted in some very interesting observations in my laboratory during the past two years.

The more important of these will be published in due course, but meanwhile the nature of the blue, violet, and red iodine adsorptions from a solution of iodine in potassium iodide in the presence of the dispersive solutions is of considerable theoretical interest to those who are working either with cellulose or similar colloidal substances.

1. A pencil of light, passing through a natural fibre of cellulose (a flat spruce tracheid, for example), the latter being deeply stained with iodine by the methods indicated above but still translucent enough to pass light, is completely polarised by absorption.

2. Two fibres stained with iodine in this way, when crossed at right angles, behave like tourmaline plates, giving total absorption of the light at the area of crossing.

3. Microscopical analysis of this phenomenon proves that the polarisation of the light is caused by ultramicroscopic crystalline particles of iodine oriented on the crystal lattice of the cellulose either as an isomorphic or an isogonic overgrowth, or intergrowth.

4. It is presumed from the optical properties of the smallest crystals of iodine observed under the microscope that these crystalline particles of iodine are rhombic prisms.

5. The iodine penetrates into the interior of the cell walls, but the concentration is greatest on the surface, where it tends to develop into an actual microcrystalline overgrowth of iodine crystals.

In other experiments definitely oriented crystal overgrowths of calcium carbonate and barium sulphate (both rhombic) have been produced on natural fibres of cellulose. In the case of natural dendritic growths (arising from a particle of bronze or copper) in paper, the actively spreading material during the fern-like growth is copper sulphide which is also rhombic in structure.

With regard to the blue and red absorptions of iodine on cellulose, which are still under investigation, the following points may be noted:

1. It is expected that some further light will be thrown on the problem of the formation of similar coloured adsorption compounds of iodine with other substances, now a subject of considerable interest in colloidal chemistry.

2. This type of adsorption of one crystal lattice upon a second may possibly take place in the dyeing of cellulose. The iodine stained fibres, like those dyed with cotton and basic dyes, are strongly dichroic. In the latter case dichroism is the only evidence of orientation, but in the case of iodine we have both strong dichroism and complete absorption of one ray giving polarisation of transmitted light. It appears probable that the dichroism of the dyed fibres may not be due merely to the orientation of the cellulose micellæ, but also to the crystalline structure of the dye micellæ similarly oriented.

3. The iodo-sulphates of quinine (artificial tourmaline or 'herapathite') which are also strongly dichroic may be isomorphous crystalline compounds, as their peculiar optical properties are clearly due to similar properties in the iodine itself.

JAMES STRACHAN.

Devonshire House,
Pelham Road,
Gravesend, Mar. 3.

Atmospheric Light Columns from Artificial Lights.

WHEN travelling by tram, I have often seen the light of street lamps drawn out into beams perpendicular to the direction of streaks left upon the window glass. Effective fibres of the cleaners' cloth are sensibly parallel, and though I had mentally noted that the beams were due to diffraction, it had not hitherto seemed worth while publishing the observation. I would suggest, however, that it provides a simple analogue for the atmospheric light columns mentioned by Dr. Currie in NATURE of April 5.

There can be no doubt that the vertical atmospheric beams are due to horizontal particles, which need not be laminar as suggested by Dr. Whipple. Some readers may find difficulty in accepting a horizontal orientation of falling particles, and it is therefore of interest to recall the observations of Dr. John S. Owens (*Brit. Assoc. Rep.*, p. 611, 1913) upon the deposition of silt and sand in water. He found that when bodies of different shape (discs, rectangular plates, or rods) were allowed to settle in water, they settled in every case in the position offering the greatest resistance to movement.

Construction of a model to produce light columns presents no difficulty in principle; all that is required is a suspension of lamellar or acicular particles within a transparent chamber having plane parallel sides. I believe I have obtained an indication of the effect with crude apparatus, but a successful result could be obtained only under rigorous conditions in which the effects of convection and tremor can be eliminated.

The apparently contradictory orientation of both lamellar and acicular particles when suspended in a fluid at rest, and when giving rise to the phenomenon

which I called '*swirl opalescence*' (NATURE, 123, 491, 1929) are consistent with the principle of least action I should like to mention that I accept Dr A S C Lawrence's suggestion (private communication) of the term '*stream scintillation*' in place of swirl opalescence HUGH NICOL

Rothamsted Experimental Station,
Harpenden, Herts, April 5

The New Planet

DANS le numéro de NATURE du 12 avril, p 577, le rédacteur de la note "The New Planet" suppose gratuitement que j'ai commis une erreur de raisonnement dans le calcul du diamètre photométrique de la nouvelle planète L'inexactitude de cette supposition se trouve démontrée par ma Note, présentée à l'Académie des Sciences de Paris dans sa séance du lundi 7 avril, intitulée "Sur le calcul du diamètre photométrique du corps céleste de l'Observatoire Lowell" (*Comptes rendus*, t 190, p 857, 1930), où se trouve précisément reproduite la formule qui m'a servi

$$\log \frac{D}{D'} = \frac{1}{5}(m' - m) - \log \frac{r'\Delta'}{r\Delta},$$

et aussi par ce fait que le calcul basé sur le carré de la distance r' au lieu du carré du produit $r'\Delta'$, ne donnerait pas 1500 km avec les constantes que j'ai indiquées ($D = 53{,}000$ km, $m' = 15\ 0$, $m = 7\ 5$, $r' = \Delta' = 45$, $r = 30$, $\Delta = 29$, $A = 0\ 6$, $A' = 0\ 15$) mais 5000 km En réalité, il s'était glissé dans *l'Information Rapide*, et ma première Note à l'Académie qui en est la reproduction, une simple erreur numérique dont j'ai publié aussitôt une rectification F BALDET

Observatoire de Meudon,
Avril 12

ALL that was stated positively in the note on M Baldet's diameter of the new planet was that his conclusion that its diameter was only 1500 km if its albedo was taken as 0 15 was erroneous His present note is in full accord with that statement, since he now gives, in *Comptes rendus* for April 7, a diameter of 2500 km, taking the albedo equal to that of Neptune, that would give 5000 km with an albedo ¼ that of Neptune

The note in NATURE went on to say (correctly) that some people had made the mistake of making the light vary as the inverse square of the distance, instead of the inverse fourth power M Baldet's letter makes it quite clear that he did not fall into this error Needless to say, the note was written and published before any correction of M Baldet's original statement had been received

THE WRITER OF THE NOTE

Influence of Chemical Colloidisation on the Anomalous Diamagnetism of Bismuth and Antimony

IT is a well known fact that antimony and bismuth possess a high diamagnetism in the solid massive state, the specific susceptibilities being $0\ 78 \times 10^{-6}$ and $1\ 17 \times 10^{-6}$ respectively at 30° C according to my experiments In a communication published in NATURE of Nov 16, 1929, p 762, I reported the results of the influence of particle size on the anomalous diamagnetism of antimony, its value falling on mechanical colloidalisation Further experiments on chemical colloids of bismuth and antimony show a still more striking decrease

Colloidal antimony was prepared by reducing a solution of potassium antimonate by sodium hydrosulphide This was centrifuged and the fine particles further purified in very dilute hydrochloric acid and carbon disulphide to remove traces of iron and sulphur The specific diamagnetic susceptibility obtained was $0\ 31 \times 10^{-6}$ with a particle size of about 100 $\mu\mu$, the particles themselves appearing as clusters of small particles

In the case of bismuth, the colloid was prepared by reducing bismuth tartrate by stannous chloride in alkaline lye and centrifuging The purified substance gave a diamagnetic susceptibility of $0\ 25 \times 10^{-6}$ (See also Honda and Owen, *Ann der Phys*, 37, 657, 1919, where Kahlbaum's colloidal bismuth is reported to give $0\ 47 \times 10^{-6}$, whereas in the massive state it is $1\ 4 \times 10^{-6}$)

These results seem to indicate that the high diamagnetism of these elements and that of graphite (Sir C V Raman, see NATURE, June 22, 1929, p 945) is a crystalline property and not atomic as diamagnetism is generally understood to be

V I VAIDYANATHAN

Annamalai University,
Chidambaram, South India, Mar 8

Leaf-Curl in Cotton

IN an article entitled 'Cotton in Africa" (NATURE, Feb 22, 1930, pp 291 292), referring to cotton in the Sudan, it is stated that 'Recently the disease known as leaf curl has been attacking the crops in this locality, and there is evidence that the jassid insect is responsible for spreading the contagion The Corporation is now considering the desirability of breeding jassid resistant strains in the Sudan"

Working in the Gezira area, which is by far the most important long staple cotton producing locality in the Sudan, I have recently proved that leaf curl of cotton (or, as it should preferably be called, leaf crinkle) is transmitted mainly, if not entirely, by an at present undetermined species of Aleurodidæ (White-flies) A preliminary paper on the subject has been submitted for publication

T W KIRKPATRICK

Wellcome Tropical Research Laboratories,
Gezira Branch Laboratory,
Wad Medani, Sudan

Mounting Media for Microscopic Work

ALTHOUGH, as Mr Wilfrid Marshall points out in NATURE of April 12, there appears to be no theoretical advantage in using a mountant containing dried Canada balsam and α bromonaphthalene, in practice the mixture has the valuable property of high viscosity The use of a medium of high viscosity enables fresh mounts to be photomicrographed at high magnification, using the microscope in a horizontal position, in fact, we now find it to be an advantage to use twice the stipulated quantity of dried Canada balsam in order to make the mountant as viscous as possible, so that film sections may be photomicrographed within a few minutes of being cut E E JELLEY

Research Laboratory,
Kodak, Limited, Wealdstone, Middlesex

An Anthropological Congress

I HAVE to day received from the Institut International d'Anthropologie in Paris a copy, dated Feb 15, and marked 'urgent', of the circular of invitation to the two Anthropological Congresses to be held concurrently in Portugal in September 1930, of which I was able to give some particulars in my letter of Mar 15, published in NATURE of Mar 29

JOHN L MYRES

Royal Anthropological Institute,
London, W C 1, April 16

Some Solar Eclipse Expeditions of 1930 and 1932

By Prof F J M STRATTON

THE two total solar eclipses of this year are not attracting organised expeditions from Great Britain The first one, on April 28, was annular over most of its path, though it was total along a narrow belt not more than half a mile wide from just north of San Francisco across Nevada and Idaho to a point north of Virginia City in Montana The uncertainty in the position of the belt was estimated at a quarter of a mile, and totality was nowhere longer than 1 5 sec An eclipse of this kind may be valuable for the investigation of the flash spectrum at different levels, and observing parties went not only from the nearby observatories of Mt Hamilton and Mt Wilson, but also from the Allegheny Observatory It is to be hoped that answers have been obtained to some of the problems which, with the aid of clouds, have been eluding eclipse observers for the past few years

The second total eclipse of this year, that of

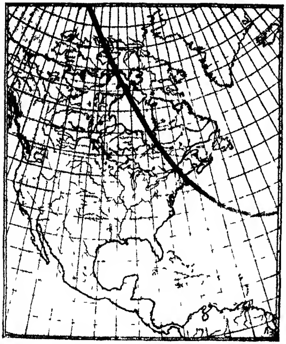

FIG 1

Oct 21-22, is visible from the small island of Niuafou in the Tonga Islands and near sunset in Chile and Patagonia Totality lasts 2 minutes The New Zealand government and the United States Naval Observatory are sending expeditions to Niuafou. A recent volcanic outburst which partially destroyed the island will add to the difficulties which must face these parties in arranging their eclipse camps, but may also appreciably add to the interest of the expeditions Dr C E Adams is going as leader of the New Zealand expedition and Prof S A Mitchell as leader of the American party

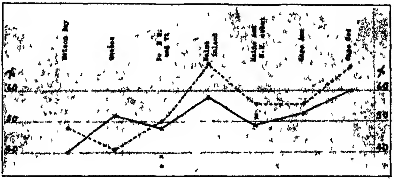

FIG 2

The next eclipse which is likely to be widely observed is that of Aug 31, 1932, visible in Canada and in the Eastern United States (Fig 1) The next ordinary General Assembly of the International Astronomical Union will be held about a week later at some nearby centre in the United States, so that a number of astronomers from other continents may be expected to observe this eclipse alongside of their Canadian and American colleagues

Five years ago Prof Todd began collecting weather observations along the track of this eclipse, and in 1929 Prof Slocum took over from him the task of collecting and collating the data He has published the results of the observations to date in *Popular Astronomy* for April, and with his permission some of his data are reproduced here As will be seen from Fig 2, the chances of success are about one half at most stations between Hudson Bay and the coast of Maine Only the intermediate stations are considered by Prof Slocum, who suggests that the best place for a camp is some distance back from the Maine coast, perhaps between East Baldwin and Fryeburg

South of the St Lawrence River in Canada, as also in the States, the central line is readily accessible by rail, and it should be easy to spread a number of observing parties along the central line At Yamachiche, on the St Lawrence River, there is a large Marconi wireless station At Drummondville, Sherbrooke, and Magog good accommodation would be available, but there should be none of the difficulties that frequently await eclipse expeditions in out of the way parts of the world, and a well distributed set of parties may hope to secure a reasonable proportion of successful observations

It should be added that totality lasts about 100 seconds, that the width of the belt of totality is about 80 miles, and that its south western edge runs from Montreal to the coast of Massachusetts midway between Salem and Gloucester

Problems of Irrigation

By Prof B H WILSDON

THE introduction of irrigation in an arid country, along with its obvious blessings, brings in its train diverse problems, as do most other of man's disturbances of Nature's equilibrium The consequences may give rise to problems of such urgency that, unless solved, large tracts of land, after a period of fertility productive of an ever increasing density of population, must lapse into saline desert or into waterlogged marsh infested with malaria Difficulties will be at their worst in flat country devoid of drainage

Terrain, soil and sub-soil, climate, the design of irrigation channels, the method of distribution of water, and the habits of the cultivator, must all be factors which contribute to the permanent success or ultimate disaster of irrigation projects Only by the systematic study of their interactions can it be hoped to secure control of effects Control is perhaps too strong a word to use when the complex reactions which follow the apparently simple engineering feat of digging a canal for irrigation are properly considered, but for the possibility of disaster we have object lessons in the ruined irrigation systems of Mesopotamia and the Punjab, which must once have supported flourishing civilisations

In the Punjab an average flow throughout the year of about 25,000 cubic feet of water a second is maintained by irrigation works by which some 10½ million acres of crops are matured in land previously desert or precariously cultivated These figures omit the great areas which are now coming into cultivation as a result of the new irrigation works on the Sutlej, and greater areas, which will be irrigable when the Sukkur barrage on the Indus is completed

Of the 10½ million acres irrigated in the Punjab, the area threatened with waterlogging has been estimated at 3¾ million acres [1]

The new areas now being brought under irrigation are probably more liable to damage than those in the Punjab, since, in general, soils become heavier and the fall of the land flatter as we proceed south

The need for research has been recognised, but not too soon As a matter of Imperial interest, the question has been under examination for some time by a special committee appointed by the Committee for Civil Research The report of this body will be awaited with interest In the Punjab, the ominous rise of the water table in many irrigated tracts, the abandonment of an increasing acreage of once fertile land through actual waterlogging and the spread of saline soil, could not be longer ignored Some preliminary steps have already been taken in an attack by scientific methods upon the analysis of the factors, and in attempts at control, by the formation in the Punjab under the Irrigation Department of a research organisation A laboratory equipped for the study of the hydrodynamic and physico-chemical problems which await solution is nearing completion, and a staff of computers for statistical investigations has been at work for some time Already some light has been thrown on the gravity of the problem, and indications of the most feasible methods of control by administrative methods or engineering works have been secured A brief account of the results obtained and the problems now more clearly defined may, it is hoped, reveal subjects of scientific interest to workers in many fields whose active interest would be of valuable assistance to those called upon to face the situation

Fortunately, due to the foresight of a former chief engineer of the Punjab—Sir Thomas Higham—extensive records have been kept for nearly thirty years of the depth of the water-table in selected wells scattered more or less uniformly throughout the irrigated tracts This valuable collection of data, with records of rainfall maintained by the Irrigation Department at sub-divisional stations, and the recorded volume of irrigation water admitted to canal distributaries, enables statistical estimates to be made, not only of the present and future rate of rise of a water-table but also of the relative responsibility of rainfall, drainage, and the irrigation load for the effects observed [2]

The method of analysis adopted has been that developed by R A Fisher [3] of the Statistical Department of Rothamsted Experimental Station in the examination of the relation between rainfall distribution during the growth of a crop and its yield This method was necessary, as there is every reason to expect that rainfall or irrigation in excess of the normal will not have the same effect on the water table at different seasons of the year since the quantity of water lost by evaporation, and able to affect the water table, must depend intimately on the prevailing temperature and humidity Moreover, well measurements have only been recorded on two dates in the year, in June and October, and the latter are not very trustworthy on account of the after effects of flooding due to the previous monsoon The method adopted was therefore to correlate the constants determining a polynomial curve fitted to the distribution of rainfall and irrigation in the year previous to the well observations, with the fluctuations of the spring levels after correction for secular trend Typical regression curves are reproduced in Fig 1 The ordinates represent the effect in the following June of unit departures from the average depth of irrigation on the rise of the water-table

Such curves represent the result of heavy computations More than three hundred individual well records are included, each of which is suitably weighted for the area of which it is taken as representative Secular change was eliminated from the record of well fluctuations by fitting an exponential curve, departures from which were

correlated with the rainfall and irrigation distribution

The available record varies from 20 to 27 years in the cases examined The unit of time was taken as five days, for each of which it was necessary to compute the rainfall from about fifty rain gauge stations and the records of many canal distributaries The correlations are undoubtedly significant according to statistical criteria, the percentage of the total variance accounted for by the regression being more than 60 per cent in the mean for the cases illustrated

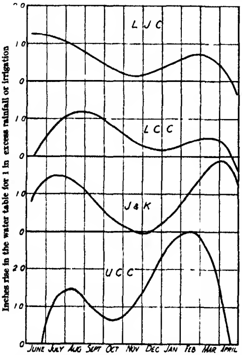

FIG 1 —Typical regression curves showing the effect of rainfall or irrigation on the rate of rise of the water table

L J C —Lower Jhelum Canal Area, 2096 sq miles recorded wells 80, perennial irrigation

L C C —Lower Chenab Canal (Upper) 2030 sq miles, recorded wells, 54, perennial irrigation

J & K —Jaurian and Kasoki distributaries Area 65 2 sq miles, recorded wells 6, the water table is high and a considerable proportion is irrigated by wells

U C C —Upper Chenab Canal Area, 2486 sq miles, recorded wells 83 the water table is high throughout the area and a large proportion receives irrigation only in the summer season A large area of rice is grown

There is a marked uniformity in the regressions for the monsoon period, July to September Roughly we see that a depth of water added to the surface of the soil as irrigation or rain produces an effect on the water table, detectable six months afterwards, of from one to one and a half times its amount This indicates that from one third to one half of the water must reach the water table from the surface, since the porosity of the soil may be assumed to lie between 30 and 40 per cent The effects of irrigation during the winter months are more diverse, as might be expected There is, in addition to the monsoon maximum, an obvious tendency to attain another maximum effect during February and March This is most marked in the Upper Chenab Canal, which differs very considerably in its agricultural regime from the others

The winter 'hump' in the regression curve has afforded an instructive insight into agricultural practice, and has been traced very conclusively to wasteful irrigation The most important application of the results has been in guiding administrative action in insistence on economy It is obvious from the curves that great effects are possible through economy, or avoidance of waste, during the monsoon, and, on certain canals, during February and March The total closing of certain canals for periods during the monsoon has been tried and would already seem to have produced promising results without undue interference with agriculture The effects in future years of the policy now adopted will be awaited with great interest

Fig 2 shows the mean observed annual rates of rise of the water table, averaged from 54 separate well records over a tract of about 2500 square miles in the Lower Chenab Canal The exponential correction for trend is also shown, as well as the fluctuations calculated by means of the derived regression equation from the recorded irrigation and rainfall The fit of the observed and calculated fluctuations in the rate of rise is remarkable

If we assume that the rise of the water table, falling off exponentially as it appears to do, will continue unchecked, it is calculated that the water-table as a whole will rise another 13 feet above its level in 1927 This must result in a very considerable portion of the area becoming water-logged By a similar calculation for the Lower Jhelum Canal, in which the water table has exhibited a remarkable rate of rise, the corresponding final equilibrium is calculated to be 56 feet above its present level

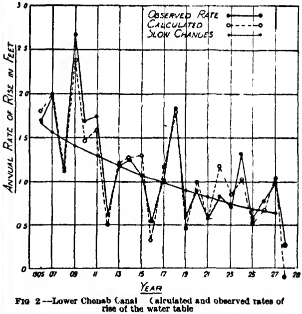

FIG 2 —Lower Chenab Canal Calculated and observed rates of rise of the water table

A second line of investigation, on which work is

still in progress, has been directed to the elucidation of the causes for such exceptionally rapid rises of the water-table as have been recorded in the Lower Jhelum Canal since the introduction of irrigation Much of the area is easily commanded by inundation canals, but the higher areas are served by high level channels from the head works at Rasul and Mangla Tradition states that the tract was once irrigated even in the higher areas, but that "God became angry" and the land waterlogged The existence in high areas of abandoned wells which show signs of use, the curbs of which lie at levels still many feet above the present water table, confirms this tradition The map (Fig 3) shows the Rivers Chenab and Jhelum At Kirana, near the district headquarters of Sargodha, occurs an outcrop of Pre Cambrian rocks associated with the Delhi and Aravalli series Similar rocks are found at Chiniot where the Chenab passes through a gorge, and at Shahkot and Sangla farther south To the north west lies the Salt Range where rocks ranging from Tertiaries to Lower Carboniferous lie unconformably over the Aravalli Cambrians It is a remarkable fact that the principal incidence of waterlogging and the areas in which the rise of the water table has been most rapid, lie to the north-east of a line roughly joining these outcrops with the Delhi ridge This suggests the possibility that the deep Indo Gangetic alluvium is traversed by a submerged ridge along this line which might act as a weir to head up the subsoil drainage Such a rock mass would account for the sensitivity of the water table upstream.

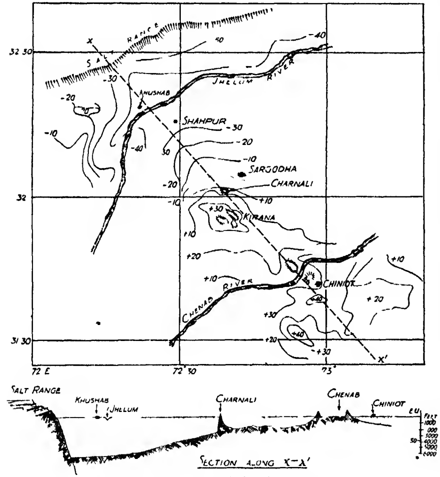

Fig 3 —Gravity survey in the Chenab Jhelum doab

It was thought worth while to substantiate this hypothesis by a gravity survey A survey party has now been in the field for three successive cold seasons, using an Eotvos torsion balance The work, which has been carried out in the field by Dr N K Bose, is not yet completed, but detailed results of the first two seasons' work will be published shortly Fig 3 shows a rough reproduction of the isogams with the omission of all detail, a section along the line X – X' is also shown Observations have been made at more than two hundred stations in the area The greatest depth of the alluvium is calculated to be about 5000 feet No other determinations of the depth of the Indo Gangetic alluvium are available for comparison, rock has never been reached by boring in the alluvium proper Extension of the results now obtained would probably be secured, at considerably less trouble than is entailed in work with the torsion balance, by the recently developed methods of seismic sounding It is to be hoped that this will prove possible in the future

It is clear that the comparatively shallow sub soils found to the south east of the tract illustrated must affect considerably its drainage, but no quantitative estimate is yet possible The rapid rise of the subsoil rock at the base of the Salt Range is a subject of considerable geological interest, but no stratigraphical conclusions as regards the type of the unconformity should be based on Fig 3

Other problems associated with irrigation must be mentioned only cursorily Satisfactory hydrodynamic theories on which may be based equations for the flow of water in a deep soil are still to be sought Even the comparatively simple case of the discharge of a tube well in a deep soil, unprovided with the conveniently situated impervious layer

always found in theoretical descriptions, is open to obvious objections The most illuminating model of such cases appears to be that of surface disturbances in an infinitely deep and highly viscous fluid This analogy has been studied mathematically by Bose [4]

The design of channels is determined primarily by the amount of silt which they must carry and discharge on the irrigated fields if the system is to remain working The transport of silt by water in turbulent flow, both as it affects the intake from the river at the headworks, and the regime of the canal, still awaits scientific description With the problems which arise in the design of irrigation works, in which model experiments, under properly adjusted conditions of dynamical similarity, alone enable three dimensional problems to be solved, enough will have been said to indicate the scope awaiting the application of mathematical and physical research

A word may be added on the agricultural problems which are inseparable from questions of irrigation Excessive irrigation and its evil effects have been mentioned, and may be regarded as a Scylla, between which and the Charybdis of the development of salinity, a safe course must be steered With sparse rainfall the salts carried in irrigation water may accumulate in the soil, so that a too parsimonious economy of water, or reversion to well irrigation without adequate replenishment of the water table with fresh water, must result in a continuously increasing salinity of soil and ground water It would appear that the only permanent solutions which can be looked for in the flat alluvial plains now considered, will be a combination of irrigation and drainage, in fact, it would be safe to state that any modern system of irrigation in alluvial plains must be designed at the outset with full provision for adequate drainage

Very much therefore remains to be done in designing effective remedies for existing systems and in the physical and chemical questions of reconditioning damaged soils

[1] Lindley *Punjab Irrigation Branch Papers* No 31
[2] Wilsdon and Sarathy *Punjab Irrigation Research Memoirs*, vol 1, Nos 1 and 2
[3] R A Fisher *Phil Trans* B **213** 309 1925
[4] N K Bose *Punjab Irrigation Research Memoirs* vol 2, 1929

Obituary

SIR GEORGE WATT, C I E

THE death of Sir George Watt removes a figure who did valuable work for India, from which he retired nearly a quarter of a century ago He will be always remembered for his 'Dictionary of the Economic Products of India" Few would dispute the very great value on Indian economic development which has resulted from this publication

Watt was born at Old Meldrum in Aberdeenshire in April 1851, the third son of John Watt He married in 1873 Jane, elder daughter of Robert Simmie, who was Customs and Excise Officer at Lossiemouth A son, Dr R H Watt, and two daughters survive him Watt was educated at the Grammar School and Marischal College, Aberdeen, and then went to the University of Glasgow in 1871, graduating M B and C M He had obtained distinction in botany, and this led to his appointment in 1872 as professor of botany in the University of Calcutta, a post he held for twelve years In 1882 he was appointed scientific and medical officer on the Burma Manipur Boundary Commission His work and enthusiasm were beginning to attract the notice of the Government of India, and in 1883 Watt was appointed to the charge of the Indian Section of the great International Exhibition held in Calcutta in that year The following year he received the definite appointment of assistant secretary for scientific purposes to the Revenue and Agricultural Department of the Government of India In 1885 he went home and held charge of the Imperial Indian Economic Court of the Indian and Colonial Exhibition, an exhibition which fired the imagination of the public school youth of the day

By this time Watt appears to have convinced himself of the grave existing need for a better knowledge of, and comprehension of, the value of the enormous number of what, *faute de mieux*, were termed the economic products of the country He was able to impress the Government of India with his views, and in 1887 was appointed Reporter on Economic Products to the Government, a new post It has been said that Watt had been turning his attention to this question of the economic products of the country and he had commenced in 1885 collecting material for the compilation of a dictionary on the subject With his official apointment he was able to take up this project seriously and by 1894 the nine fine volumes of the "Dictionary" were completed The work was a standard one and, unfortunately, owing to the unexpected demand, went out of print at an early date

When Watt compiled the 'Dictionary" there was no Agricultural Department to the Government of India, no Pusa and no Forest Research Institute at Dehra Dun Watt's project was invaluable but, with no idea of belittling his magnificent work, it should be stated that the "Dictionary would never have seen the light of day had it not been for the loyal, intelligent, and enthusiastic assistance accorded to him by collectors and deputy commissioners of districts and their staffs, and by the forest officers throughout the country and the latter, owing to their training in scientific method and deduction, were perhaps in a better position to submit reports in a readily utilisable form Many, if not most, of the inquiries originated with Watt, and circulars were issued asking for co operation in instituting investigations and often in carrying them to a conclusion, where practicable, out in the districts There is little doubt that Watt's initiative in this respect aroused the interest of many junior officers in this matter of economic products

I had not been three months in India before a conundrum in one of the circulars was given me to deal with, and several most interesting months were passed in endeavouring to submit a satisfactory solution

The "Dictionary" was not intended as a text book or handy handbook, but it was a first definite departure in the study of the economic products and served as the basis for the great development of this study which has since come about Watt retired in 1906, but the post of Reporter was not finally abolished until both the Pusa and Dehra Dun Institutes were firmly established Watt's ledger files, which he had maintained over a long period of years, were then made over to these latter He had also edited an invaluable publication known as the *Agricultural Ledger* from 1892 to 1903, which was continued by his successors He was also in charge of the industrial section of the Indian Museum at Calcutta

It was during Lord Curzon's Viceroyalty, to some extent due to the fact that the "Dictionary" was out of print, that Watt was asked to prepare, with the guidance of a small expert committee in London, an abridged edition of the "Dictionary", to be brought up to-date and to be issued in one volume This work, under the title of "The Commercial Products of India", was published in 1908

Watt was president of the Pharmacological Section of the Indian Medical Congress in 1894 In 1901 he was appointed to the Indigenous Drugs Committee, and as secretary drafted the report In 1903 he organised an Indian Art Exhibition in connexion with Lord Curzon's Delhi Durbar

After his retirement from India, Watt made a special study of cacao cultivation, visiting Portuguese West Africa for the purpose in 1912, and patented machinery for cacao manufacture He served for five years as lecturer in the botany of Indian trees at the University of Edinburgh He was made C I E in 1886 and was knighted in 1903, he was LL D of both his old Universities, Aberdeen and Glasgow, a fellow of the Linnean Society, and had received distinctions from a number of foreign universities and scientific societies

In addition to the "Dictionary", Watt published "Pests and Blights of the Tea Plant", "Rhia and China Grass", "Lac and Lac Industries of India", and an important work on the "Wild and Cultivated Cotton Plants of the World"

Watt had settled at Lockerbie in 1910 and identified himself closely with local affairs, serving on the Dumfriesshire County Council and Education Authority His death on April 2 will be much felt by many, and not least by the band of men who were identified, one way or other, with his valuable Indian work

E P STEBBING

PROF I P BORODIN

PROF IVAN PARTHENIEVITCH BORODIN, whose death at Moscow was recently announced, was a botanist and forester of international reputation Born at Novgorod in 1847, he was educated at the University of St Petersburg, where he became professor of botany in 1887, a position he held for three years He then became professor at the St Petersburg Forest Institute, where he continued for thirty years This was formerly the largest and probably the best equipped forestry school in Europe, and many foreign students were attracted to it by the prestige of Borodin and the scientific staff In 1897 he founded the biological fresh water station which bears his name and of which he was director

Borodin's first researches were on the effect of light on the higher cryptogams, and he also worked on respiration An early paper, however, on botanical progress during 1877–79, indicated the catholicity of his interests shown later by his publications on mycology, anatomy, reproduction, and biochemistry He also wrote standard books on botany and agriculture

The study of botany in Russia owes much to Borodin's zeal and versatility, and this is shown by the numerous honours conferred upon him He was of strong physique and enormous energy, attributes which served him in good stead in the arduous botanical travels he undertook in the remoter parts of Siberia and the Caucasus His interest in travel continued to the end, and he served as president of the standing commission for the development and exploitation of tropical countries He held several other positions to which the term honorary is usually applied, but Borodin devoted himself to his duties with intense earnestness and clear thinking enthusiasm He was a man with many friends in his own and in other countries

PROF HERMAN VON IHERING

PROF HERMAN VON IHERING, who died at Budingen in Oberhessen on Feb 24 in his eightieth year, is well known from his contributions to the biology and palæontology of South America, where he was for many years Director of the Museum at São Paolo, Brazil

Von Ihering was especially interested in zoogeography and in order to test its problems by various groups of animals, specialised on land and freshwater mollusca and on the social insects, especially the wasps He had also a good knowledge of the South American mammals, recent and fossil He also wrote on the Antarctic faunas, the German Selachians, and the fossil and living mollusca of South America He was a man of original and independent views and was often engaged in controversy, on one occasion with Ray Lankester He was a pioneer in the application of parasites to zoogeography and it is often called "the von Ihering method"

Von Ihering wrote many memoirs on the anatomy and classification of the land mollusca and on the biological relations of South America His last general work was his "Die Geschichte der Atlantischen Ozeans" (June 1927), wherein he summarised and restated his former conclusions, and advocated fundamental changes in both Atlantic and Pacific geography up to the middle of the Kainozoic era

After his return from South America, von Ihering was honorary professor of palæontology in the University of Giessen Many of his views were rejected when first advanced, but are now receiving wider recognition and acceptance

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PRINCIPAL J YULE MACKAY

JOHN YULE MACKAY, whose death on Mar 30 we regret to record, was a distinguished student of the University of Glasgow After graduation in medicine in 1882, he became Cleland's senior demonstrator and lecturer on embryology

Mackay was successful as a teacher, and, in addition, he produced original work of permanent value He devoted his attention mainly to the vascular system, and wrote a monograph on the morphology of the arterial arches in birds which was published in 1888 in the *Transactions of the Royal Society* He was with Cleland the originator of the ' Memoirs and Memoranda in Anatomy " which was issued from the Glasgow School, and its first volume, published in 1889, contained an interesting paper by him on ' The Arterial System of Vertebrates Morphologically Considered ", in which from his comparative observations, he constructed a scheme of the classification of the branches of the aorta, the correctness of which has been confirmed by subsequent embryological observations His ability and energy were shown also in the volume on Human Anatomy General and Descriptive ", which he produced in association with Cleland

Shortly after Mackay's appointment to the chair of anatomy in University College, Dundee, he was selected to be the principal of that College, and he held the dual posts until a few years ago, when he resigned the chair but retained the principalship He was for many years the University representative of the University of St Andrews on the General Medical Council, and until recently was the chairman of the Education Committee of the Council

D W

WE regret to announce the following deaths

Dr J H Appleton, emeritus professor of chemistry at Brown University, known for his work in industrial chemistry, on Feb 18, aged eighty six years

Dr Asaph Hall, of the U S Naval Observatory, vice-president in 1900 of Section A of the American Association for the Advancement of Science, who was known for his work on the orbits of planetary satellites, on Jan 12, aged seventy years

Prof Conrad Keller professor of special zoology in the Technical Highschool, Zurich, author of works on the origin of domestic animals, aged eighty two years

Dr W A Orton, director of the Tropical Plant Research Foundation, formerly plant pathologist in the U S Department of Agriculture, and president in 1921 of the American Phytopathological Society, on Jan 7, aged fifty two years

Dr R F Ruttan, emeritus dean of the faculty of graduate studies and research at McGill University, past president of the Royal Society of Canada and of the Society of Chemical Industry, on Feb 19, aged seventy three years

Prof L Vialleton, honorary doyen of the faculty of medicine of the University of Montpellier author of works on histology, evolution, and other zoological topics, aged sixty nine years

News and Views

ON May 10 occurs the centenary of the birth of the distinguished French chemist, François Marie Raoult The son of a customs officer, he was educated at Laon and Paris, became a teacher, held various appointments at Rheims and elsewhere, and in 1870, at the age of forty, succeeded to the chair of chemistry at Grenoble, where the remainder of his life was passed His earliest researches were largely connected with the phenomena of the voltaic cell, but his name is best known for his work on solutions, which occupied the last two decades of his life His first paper on the depression of the freezing points of liquids by the presence of substances dissolved in them was published in 1878 Continued experiments with various solvents led him to the discovery of a simple relation between the molecular weights of substances and the freezing point of the solvent which he expressed in the " loi générale de la congélation " He also studied the diminution of the vapour pressure of a solvent caused by dissolving a substance in it, and his important work in these directions was afterwards used by such eminent investigators as van 't Hoff and Ostwald in support of the hypothesis of electrolytic dissociation in solutions An account of his work was given in a memorial lecture in 1902 by van 't Hoff before the Chemical Society, of which Raoult had been elected a foreign member in 1898 A modest, retiring, and dignified man, he lived mainly for his work, the value of which was recognised by the award of prizes by the Paris Academy of Sciences and of the Davy Medal of the Royal Society His death took place on April 1 1901

FOR the public Kew is a delightful pleasaunce for the gardener a demonstration of achievement and a suggestion of possiblities, and for the botanist a store house of information and a centre for research The recently issued number of the *Bulletin of Miscellaneous Information* (Appendix I, 1930), comprises under this familiar but somewhat unattractive title, a review of the work of the various departments of the Royal Gardens during 1929 In 1925 work was begun on the formation of a National Pinetum at Bedgebury, in Kent, as the nearness of London is not conducive to the growth of conifers, and in spite of the long cold winter and abnormally dry summer of 1929, good progress is reported The abolition of the penny charge for admission to the gardens from August Bank Holiday onwards is reflected in an increase in the number of visitors of nearly 220,000 between August and December, as compared with the corresponding period in 1928 The hard winter of 1928–29 and the boisterous gales of the last two months of the year caused severe losses among shrubs and large trees, but the long hot summer gave an unusual brilliance of colour to the abundant crops of fruits and berries on

many of the trees, and the later incessant and heavy rains effectively cleansed trees and shrubs from soot and dirt

THE more strictly botanical activities of the Royal Botanic Gardens, Kew, have benefited by generous grants from the Empire Marketing Board, which have rendered possible visits by the scientific staff and various collectors to different parts of the Empire overseas and elsewhere, resulting in valuable accessions to the gardens and herbarium, and the gain of invaluable experience to individual members of the staff Mr Hutchinson's botanical tour in South Africa produced a harvest of more than 3000 species, including a large number of living succulent plants Work of botanical exploration has also been carried out in British Guiana, Persia, Somaliland, and the Solomon Islands Considerable additions have been made to the herbarium, mainly by the incorporation of stored material An important feature of the work is the international co operation in research rendered possible by an extension of the system of reciprocal loans between important botanical institutions, during the year more than 9000 specimens were borrowed and nearly 6000 sent out on loan Botanical work in South Africa will be greatly facilitated by an arrangement to present to the National Herbarium at Pretoria duplicates of authentic specimens in the Kew Herbarium The report of the museums records an increasing interest taken in the economic products of plants, involving much correspondence and discussion of home and colonial products with visitors The difficulty in answering questions as to possibilities of new crops for home or the colonies is often enhanced by the lack of discretion on the part of optimistic journalists An interesting acquisition is a new sun dial constructed and presented by Prof C V Boys, which was described in NATURE of Dec 21, 1929

WE have received a letter from Prof G E Gates, of Judson College, Rangoon, in which he directs attention to the loose way in which authors of zoological papers still frequently refer to species of earthworms, even when these actually supply the material of their investigation Thus a recent writer speaks of "the common Australian (European) earthworm", the question is, What is meant? Presumably, says Prof Gates, one of the peregrine Lumbricida that have been imported into Australia and have become acclimatised in settled areas around the cities But "at least six species of Lumbricids have been recorded from Australia *Eiseniella tetraedra*, *Eisenia fœtida*, *Allolobophora caliginosa*, *Bimastus constrictus*, and *Octolasium lacteum* These worms when found elsewhere are usually present in considerable numbers, so that to each one of them the adjective 'common' might be applied Thus an investigator who procures his earthworms from manure piles might regard *E fœtida* as the common species, while another investigator who gets his material from the very same locality but at a distance of a very few feet from the manure piles would probably find another species to be the common form Similarly a thick grove or river bank only a short distance from both the preceding places might have still other common species The phrase 'the common earthworm' in such a region must therefore be nearly as meaningless as 'the common bird' or 'the common fish' would be" Even though one of these species should happen to preponderate so largely in one particular place as to deserve the name, locally, of 'the common earthworm', outsiders cannot be expected to know which is meant The importance of the matter, as Prof Gates points out, lies in the fact that in such cases corroboration of the results obtained is impossible, and their value, therefore, very considerably diminished, because of the anonymity in which the animal concerned is shrouded It is not only the Oligochæta which are thus cavalierly treated by authors, in the same paper which calls forth these remarks, the monocystid parasites with which the writer is concerned are also left specifically undetermined

THE issue of the *Times* for April 26 contains a letter from Sir John Rose Bradford, president of the Royal College of Physicians, in his capacity of Chairman of the Harvey Church Memorial Fund, appealing for funds for the restoration of the tower of Hempstead Church, Essex, the resting place of William Harvey, which collapsed in 1882 An appeal was made in the *Times* last January not only to individual practitioners of medicine, but also to medical corporations, institutions, societies, and schools, with the result that some £1500 of the £5700 required has been raised The present appeal is primarily directed to members of the medical profession, by whom Harvey is generally regarded as second only to Hippocrates, but it is hoped that it will provoke a generous response from laymen as well, particularly those who can appreciate Harvey's exhortation to the fellows of the Royal College of Physicians 'to search and study out the secrets of nature by way of experiments' The present dilapidated condition of Hempstead Church has not infrequently created an unfavourable impression upon the foreign medical men who have made a pilgrimage to Harvey's tomb A new importance is now assumed by the erection of a worthy memorial to Harvey at a time when, as we noted in our issue of April 19, a special effort is being made to establish a post graduate school of medicine in London and to attract foreign students to Great Britain Donations should be made payable to the Harvey Memorial Fund, and may be sent to the honorary treasurer, Mr A W Ruggles Brise, Spain's Hall, Braintree, or to Dr Arnold Stott, 58 Harley Street, W 1, who is joint honorary secretary with the Vicar of Hempstead

AN interesting tradition has long been current that Comenius (Jan Amos Komensky) the famous seventeenth century pedagogue, was invited to accept the presidency of Harvard College, founded in 1636 The evidence that such an offer was made by the younger John Winthrop (1606–76), Governor of Connecticut, rests upon the authority of two references to it by Cotton Mather, of Boston, in works published in 1702 and 1726 Recently, Mr R FitzGibbon Young has re examined the evidence

("Comenius and the Indians of New England", pp 28 University of London School of Slavonic Studies Price 3s net) and, by taking into consideration the circumstances of time and place, has concluded that whilst there is definite evidence that Comenius was invited to New England, the presidency of Harvard was not vacant when Winthrop could have seen him Nevertheless, his pan sophic educational schemes received the careful consideration of contemporary American educationists Mr Young has also traced Comenius's connexions with Robert Boyle, Dr Wilkins, Sir Kenelm Digby, and other members of the "invisible college" which was later to become the Royal Society It would seem that the intention of certain savants, both in England and America, was that Comenius's methods of instruction should be applied to the unsuccessful attempt then set on foot for educating the American Red Indians upon the most advanced western European lines Nothing came of the project, but Comenius's views can still be regarded as of some historical interest

FOLLOWING the decisions at Dusseldorf in 1910, the sixth session of the International Congress of Mining, Metallurgy, and Applied Geology will be held at Liège on June 22–28 next during the International Exhibition of 1930 These meetings will be under the gracious patronage of His Majesty King Albert and of the Belgian Government The Congress has been organised by the Liège Association of Engineers and the Geological Society of Belgium at Liege, in consultation with the societies which took part in the Conference at Dusseldorf The work of the Congress will be divided into three sections (*A*) Mining Section, which will include reconnaissance and pre liminary work, modern methods of working coal mines, metalliferous deposits and quarries, genera tion and utilisation of energy, extraction, ventilation (gas and dust), and mechanical treatment of ores and coal, (*B*) Metallurgy Section, which will deal with blast furnace practice, steel and ferrous alloys, foundry work, non ferrous alloys and fuels, (*C*) Applied Geology Section, covering metals, fuels, hydrology, and geophysical prospecting Further information can be obtained from the general secretary of the Organising Committee, 16 Quai des États Unis, Liège

EVER since its formation in 1884, the North East Coast Institution of Engineers and Shipbuilders has paid attention to engineering education, and in 1903 and 1907 it published reports on the training of apprentices After the reading of a paper in October 1926 by Sir T Morison entitled 'How should an Engineer be trained?", the Education Committee of the Institution was requested to consider the training of candidates for official positions in the engineering and shipbuilding industries, and, in a short but valuable report entitled "Engineering Training for Officer's Rank", the results of its inquiries have just been published 'Officer's rank' is considered to denote that a person possessing it has a reasonably broad acquaintance with the application of scientific principles to engineering, a certain amount of scholarship, and some practical knowledge of all the trades or professions which are employed in engineering works, while the report refers mainly to the training of marine and mechanical engineers, shipbuilders, and naval architects

THE Education Committee of the North East Coast Institution of Engineers and Shipbuilders regards the obtaining of a university degree in applied science as assuring a satisfactory standard of scholarship and as the normal road to officer's rank in the engineering profession, but one of the points stressed in the report is the desirability of a preliminary training in the works before the student enters upon his university course "It is extremely desirable, as a preliminary to entering the university, that some experience of handling and fashioning actual materials, and of seeing what engines and ships and their parts look like in different stages of their construction, should be acquired" This view was supported by 94 per cent of the firms to which a questionnaire was sent Appended to the report are outline schemes of training for both the shipyard and the engineering workshop The carefully considered views of the Committee will be read with interest by those teaching in technical schools and colleges, and the report should also be of value to parents of boys desirous of becoming engineers

THE opening of direct electrical communication between Madrid and Buenos Aires on Oct 12, 1929, marked the completion of a wonderful engineering feat for which the International Telephone and Telegraph Corporation deserves great credit The radio link installed is capable of connecting any telephone in the principal cities of Europe to any telephone in the principal cities of Argentina, Chile, and Uruguay The length of this link (6400 miles) is twice as great as that connecting Britain with the United States The radio path cuts the meridian at the equator at an angle of about thirty four degrees It passes through zones notorious for atmospheric disturbances and through the equatorial region where radio transmission is particularly subject to fading Devices have been installed to counteract the effects of fading and, in addition echo suppressor circuits which prevent the speech being reflected at the distant ends have been permanently installed In order to give a trustworthy service over the entire day, three wave lengths are used at each transmitter A wave length of 15 metres (20,000 kilocycles) is employed in the daytime, 20 metres for sunset and sunrise conditions, and 30 metre waves (10 000 kc) are used at night In order to reach Montevideo in Uruguay and some of the important cities in Argentina, it was necessary to place a telephone cable under a very broad portion of the River Plate and to cross some very high mountains where snow prevents train traffic at certain periods of the year Serious trouble has been experienced in Argentina where enormous cobwebs are blown by high winds into the circuits and effectively short circuit them In *Electrical Communication* for February many details are given of the system Extensions have been made to Chile, which will add

many cities in that country to the Buenos Aires Madrid link In two years' time the toll plant to Bogota will add Colombia to the system

The transmission systems for railway electrification which are used in the Swedish State railways are novel and deserve special study by railway engineers We therefore welcome a paper by I Ofverhohm, the chief electrical engineer of the State railways, which is published in the *ASEA-Journal* (Allmanna Svenska Elektriska) for December At the end of the year 1928, nearly six hundred miles of the State railways had been electrified and the electrified portion carried nearly a quarter of the whole traffic (in train-miles) of the railway system Owing to special reasons, alternating current was used The power required for the Kiruna—Riksgransen line, the so called Ore railway, is produced by separate generators at the Porjus power plant, which is then stepped up to 80,000 volts for the transmission lines which extend for 250 miles along the railway, the average distance between the substations being about 20 miles The southern part of the State railway from Stockholm to Göteborg, which is called the western trunk line, is supplied with electrical power from the national high voltage three phase transmission lines The voltage between the trolley wires and the earth in the Ore railway is 16,000 volts, and the frequency is only 15 The important difference between the two sections of the State railway is that for the Ore railway special transmission lines and transformer substations had to be constructed in addition to the trolley lines In the latter case it was only necessary to construct motor generator stations in addition to the necessary trolley wires One objection that has been often urged against the use of alternating current is that it would produce interference with telegraph and other communication circuits The Swedish engineers seem to have overcome very easily by various methods described in the paper any troubles arising from this cause

A Report on "Rational Organisation and Industrial Relations", which consists of a symposium of views by members drawn from the spheres of management, labour, and science, has recently been published (The Hague International Industrial Relations Association, 1930 3 50 fl, 6s, to Members of the Association, 2 50 fl, 4s) In a paper on "Rational Organisation", Mr L Urwick, director of the International Management Institute, Geneva, defines a rational or scientifically organised industry as a group of enterprises engaged in supplying similar or allied requirements to the community by methods involving the minimum waste of either effort or material Rationalisation, he holds, is both an attitude and a process As an attitude, it records the belief that a more rational control of world economic life through the application of scientific method is possible and desirable, As a process, it implies the application of scientific intellectual technique to all problems arising in the organisation and conduct of production, distribution, and consumption An important lesson which recent experiments in scientific management have to teach is that the art of management and of organising large bodies of men must be based on a searching intellectual study of the underlying sciences bearing on it, coupled with that power of synthesised expression which is the distinguishing hall mark of real ability Scientifically managed industry of the future will necessarily involve a substantial degree of workers' control, but the mechanisms and forms of that control would accord rather with the findings of comparative administration than with any political preconceptions "Personnel Policy and Procedure" is discussed by Dr C H Northcott, labour manager of Messrs Rowntree and Co, Ltd, who holds that management should not wait for the workers to make a proposal Even in such matters as wages, it is unfair to the workers that a grievance known to the management should remain uncorrected until complaints are made

In the *Engineer* for April 11 is an illustrated article on the s s *Seapro*, a fish treating vessel which has just sailed for the south west coast of Africa Fish of many kinds are caught in the waters in that area, some of which are only fit for conversion into food for cattle, pigs, and poultry, some of which are valuable for their oil content, others the livers of which provide medicinal oil, and shellfish that furnish a table delicacy when tinned Finally, there are other fish which are worth putting into cold storage for sale at any convenient market To deal with these various classes of fish, the *Seapro* has been fitted up as a factory with hacking machines for tearing the fish into small pieces, drying machines for expelling the water, sterilising machines in which the albumen is coagulated and bacteria killed by being subjected to high temperature, a complete tin making plant for making tins, and others for boiling and canning cray-fish and for boiling the oil out of fish livers The machinery, which is driven by electric motors, has been constructed by Rose, Downs, and Thompson, Ltd, of Hull, who specialise in the construction of fish meat plant The actual fishing will be done by a fleet of motor boats the crews of which will be recruited locally but who will live on board the *Seapro*, in which extensive native quarters have been provided The *Seapro* is a vessel of 5305 deadweight tonnage, and before being altered for her present purpose was, under another name, engaged in the pilgrim traffic in the East

The cost of books to the reader, relative to the publications of different countries and to succeeding years, is not easy to assess with strict accuracy, and on this account the statistics collected by John R Miner must not be pushed too far (*Quart Rev Biol*, p 598, 1929) They refer to the cost of the biological books received for review in 1929 by the journal mentioned If these may be taken as fair samples of national production, of the great nations Germany heads the list as the most expensive retailer (1 65 cents a page), followed by England (probably meaning Great Britain—1 29 cents), United States (1 14), and France (0 47) The cheapest of all biological books are those published by the United States Government,

and next to them appear to come those of the British Government, but this statement is founded on a single example only It is very striking, however, that during the four years of this annual survey, France has continued to produce the cheapest commercially published scientific books, costing on the average less than half as much as those of any other country In all countries 1929 was marked by rising prices, varying from an increase of 18 3 per cent in British books to 4 4 per cent in French, United States commercial books show no difference, but their Government publications have risen 9 5 per cent The longer view shows that while British and American books stand now practically at the price level of 1926, French books in the same time have increased in price 34 3 per cent and German books 51 4 per cent

Dr A Nodon has contributed an article to *Savoir* (Mar 15) which again raises the problem of the nature and origin of the cosmic rays It seems to be undecided at present whether they are electromagnetic waves or corpuscles Prof Millikan's interpretation of the accurate absorption curves obtained by him and by his collaborators is not everywhere accepted, but, on the other hand, the evidence that the rays are corpuscular is as yet not completely satisfactory Their place of origin, again, cannot be regarded as settled in the absence of more complete statistical analysis of the type made by A Corlin, the accumulation of data for which is necessarily a lengthy procedure Dr Nodon has directed attention to the work on the cosmic rays which has been done in France at various times since the discovery that there was a real residual ionisation in electroscopes The feature of the French work is that it tends to show that the penetrating radiation comes in part directly from the sun, and in part indirectly from the upper atmosphere, but not from the sun The present position is most unsatisfactory and it does not seem possible to pronounce any certain judgment on the questions at issue

The anthropological surveys carried out and planned by the Bernice P Bishop Museum at Honolulu promise to add much to the knowledge of the people of Polynesia The Museum was founded in 1889 as a memorial to the Princess Panahi, last of one of the branches of the chiefs of Hawaii, with the stated object of the advancement of knowledge of " Polynesian and kindred antiquities, ethnology, and natural history " It was recognised that the problems of anthropology should be given a preferred position owing to the rapidity with which, on the death of the older people and in the absence of written records, reliable sources of information regarding native language, music, myths, social organisation, industries, and history, disappear In carrying out the surveys, the investigators have, as it were, kept an eye on the clock, realising that vanishing data must be gathered at all costs, and that less urgent studies may well be excluded from the programme of immediate work For the purposes of the survey, Polynesia has been divided into twenty six areas, and eighteen surveys have been completed or organised In addition to its ethnographical work, the Museum has done much to elucidate the flora and fauna of the Hawaiian area

The Zoological Survey of India was a fine conception which took shape under the enthusiastic guidance of the late Dr Nelson Annandale, and the report for the years 1926–29 shows how solid is the foundation being laid for a knowledge of the fauna of India Concerned equally with the field work on which advance of knowledge must be based, with the preservation and storage of the materials collected, and with the identification of specimens, the Survey finds its labours hampered in several directions The director, Col R B Seymour Sewell, suggested, therefore, that besides additional staff, there was need for a fire proof building to house the collections, the library and laboratories, and of a marine biological station at Karachi Force of circumstances has prevented the completion of these projects, but the appointment of an anthropologist should be of great service from the point of view both of the public galleries and of the scientific collection of data Field work has been carried on in various areas, and now that the Chilka Lake survey has been completed, attention has been turned particularly to the fauna of the Nerbudda River Appendices, occupying 44 pages, give lists of collections sent out and received, of an impressive series of type specimens added, of papers published, and so forth, but in these days of expensive printing, full lists of specimens added to the exhibited collections, of odds and ends received for identification, or of workers who used the library or laboratories, might be omitted without serious loss

The Zoological Society of London has had another most successful year According to the Report for 1929, the number of visitors shows a decline from that of the previous year and the realised profit has fallen But the former still exceeds two millions, and the latter, at £12,059, is in reality an improvement on the previous year, since there has already been debited against profit a non recurrent loss of £2742 due to the centenary celebrations The number of animals in the collections remains much the same as before—4095, excluding fishes and invertebrates—and this in spite of an abnormally high mortality amongst small mammals and birds which took place during the exceptionally severe and prolonged frost in January and February of last year Otherwise the collections show a wonderful freedom from disease, for we can reckon out of count the deaths of thirteen penguins imported from the Falkland Islands in an infected condition The gratifying decrease of tuberculosis, to which we have referred before, continues, the records showing ten cases fewer in mammals and eleven in birds, with only two cases amongst the Primates, as against forty one in 1926 amongst the inhabitants of the old ape, monkey, and lemur houses—a fine justification of the new housing policy In view of the scare regarding psittacosis, it is reassuring to learn that no case of this disease has been detected and no outbreak of epizootic disease has occurred in the Society's aviaries during the year To the Report are appended the addresses by His

Grace the Duke of Bedford and Sir P Chalmers Mitchell at the centenary celebrations, as well as shorter addresses by three representative delegates

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A temporary technical assistant in farm economics under the Department of Agriculture for Scotland—The Establishment Officer, Department of Agriculture for Scotland, Queen Street, Edinburgh (May 10). Designers with experience in the design and construction of light precision mechanical or electrical machinery, for an Admiralty establishment near London—The Secretary of the Admiralty (C E Branch), Whitehall, S W 1 (May 10) A physiological botanist under the Director of Agriculture, Mauritius—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W 1 (May 16) A university librarian for the Queen's University, Belfast—The Secretary to the Library Committee, Queen's University, Belfast (May 16) A head of the Building Department of Leeds Technical College —The Director of Education, Education Department, Calverley Street, Leeds (May 17) A senior science master at the City of Leeds School—The Director of Education, Education Department, Calverley Street, Leeds (May 17) A chief assistant in the Pottery Department of the North Staffordshire Technical College — The Clerk to the Governors, North Staffs Technical College, Town Hall, Hanley, Stoke on Trent (May 19) A junior lecturer in the department of inorganic and physical chemistry of Bedford College for Women—The Secretary, Bedford College for Women, Regent's Park, N W 1 (May 24) An assistant horticultural adviser to the County of Southampton Education Committee —The County Education Officer, The Castle, Winchester (May 24) An assistant director of agricultural education, a senior agricultural advisory officer, and a poultry advisory officer—The Director of Agricultural Education, Agricultural Station Offices, Sprowston, Norwich (May 24) A head of the mathematics and physics department of the Birmingham Central Technical College—The Principal, Central Technical College, Suffolk Street, Birmingham (May 30) An assistant lecturer in the department of mathematics of the University College of Swansea—The Registrar, University College, Swansea (May 30) Assistant meteorologists under the India Meteorological Department—The Director General of Observatories, India Meteorological Department, Poona 5, India (June 29)

Our Astronomical Column

Double Star Measures at Johannesburg — *Circular* No 80 of the Union Observatory is wholly occupied with double star measures made by Mr W H van den Bos There are 1393 measures of 604 pairs, the 9 inch refractor is used for such pairs as are within its reach, the 26½ inch for more difficult ones Some pairs within reach of northern observers are measured for a check on personality in measuring One of these is Sirius, there are five measures of the principal pair *AB*, which agree closely with the ephemeris from Aitken's orbit, two measures of the suspected third companion *C*, date 1929 213, give P A from *B* 132 6°, distance 1 54", the note on one night is "*C* sharp and stellar regarded as quite certain, good measure", but a later note states that the real existence of *C* is still regarded as doubtful A bar across the object glass was found to aid observation in this case, there were dark lanes between the diffracted patches of light, a faint object in these lanes was more easily seen, it is suggested that the device might be useful for Procyon Three companions of Nova Pictoris were measured, position angles, 70°, 230°, 10°, distances, 0 5", 0 6", 0 3", dates not given An interesting new close pair is ν Indi, magnitudes, 6 1, 6 2, P A 0°, distance 0 14" As this star has a parallax of 0 034" (Voute), it is likely to show orbital motion With the circular are issued twelve more sheets of the photographic star atlas of the southern heavens that is being made with the Franklin Adams camera, they are ruled with the lines of R A and Decl for the equinox of 1875

A New Determination of the Galactic Pole —*Publication* No 43 of the Groningen Laboratory, by Prof P J van Rhijn, director of the Laboratory, is taken up with a careful analysis of the distribution of the faint stars, based chiefly on the photographs of the Kapteyn selected areas, but supplemented by the Franklin Adams photographs and some other sources The stars used are very much fainter than those employed in obtaining the galactic co ordinates that are in common use, it is therefore not very surprising to find that the new position of the galactic pole differs considerably from accepted values Thus, in the analysis the preliminary position of the galactic pole was that derived by Gould, R A 12h 42m 34s, N Decl 27° 13', that finally adopted is 12h 56m, N 25° 30' (both are for the equinox of 1900) The publication contains tables for reducing R A and Decl to this new system, the remainder of it contains extended tables of the logarithms of the star density for different magnitudes and in different regions of the sky The important result is deduced that the ratio of increase in the number of stars on extending the table from any magnitude (between the limits 15 and 18) to a value half a magnitude fainter is independent of the galactic longitude, and is the same on both sides of the galaxy

Melbourne Astrographic Catalogue, Vol 3 —This catalogue has just been published under the direction of the present Government Astronomer, Mr J M Baldwin, most of the photographs were taken and measured under his two predecessors, Messrs Ellery and Baracchi It covers the zones − 69° and − 70°, so that about half the stars in it occur twice, since each plate covers 2° in declination There are 254 pages, and the average number of stars on each page is about 200 The diameters of the star images are given, and a table in the introduction gives the magnitude corresponding to each diameter the faintest stars are of magnitude 12 9 The rectangular co ordinates *x*, *y* of each star are given to the third decimal of a minute, there are tables to facilitate the reduction to Right Ascension and Declination The stars used for the plate constants are in heavy type The reference numbers in the Cape Photographic Durchmusterung are given for all stars contained in that work, together with their magnitudes The Melbourne section of the catalogue extends to the south pole, but the zones near the pole are very small, so that about half the whole area has now been published

Research Items

Polynesian Anthropometry.—Prof. Wood Jones prefaces a discussion of the anthropometry of the Polynesians in *Man* for April with certain preliminary considerations which he commends to the attention of anthropologists. First, that the question of the origin of the race has been obscured by a tendency to confuse the point of their mixed origin with that of a tendency to hybridisation shown in the agelong toleration of admixture with alien blood; secondly, that anthropologists have neglected the methods of their fellow workers in other branches of zoology, though recently Sir Arthur Keith has brought the study into line by regarding human races as varyingly perfected stages of human evolution; thirdly, correlation of growth must not be overlooked; for example, the correlation in length of vertebral column, base of skull, and maximum head length. Turning more specifically to Polynesia, can anthropometric methods demonstrate, aside from recent admixture, the original blending of separate racial elements in the formation of a Polynesian type? Sullivan's observations were summed up by him as demonstrating two races in Polynesia. This was based on a method of selecting one characteristic and noting the status in a series in regard to other features; thus from an examination of "23 tallest men", "21 shortest men", and so forth. But in view of the zoological principle mentioned above, the results probably denote no more than that they represent the tallest and shortest individuals with the usual correlations of head and face. The same distinctive classification is obtainable from Burton's tables of Australian aborigines, but no one would suggest that this homogeneous group is derived from the crossing of two racial strains. The same criticism applies to the frequently repeated classification of the bones and skulls found in English Church crypts into 'conquerors' and 'conquered'—'Romans' and 'British', 'Saxons' and 'Danes'.

Origin of the Caste System in India.—In the *Indian Antiquary* for March is published the first instalment of a discussion of the origin of the caste system in India by the late Mr. Charles Hill. The civilisation of India is utterly different from any other type in the world. The word 'caste', of Portuguese origin, means 'purity'. The system is aristocratic in that birth is considered essential to the possession of certain qualities, yet it is democratic in the fact that theoretically the members of all the groups are on an equal footing. Expulsion, which follows on any cause, however slight or accidental, leads to the formation of a new caste when the breach is great or intentional, or a sub-caste when it is slight and accidental. The result is that there are now more than 2000 castes and sub-castes. According to tradition, the Hindus were originally divided into four castes only—Brahmans, a spiritual priesthood, Kshatriyas, warriors sprung from the arms and shoulders of Brahma; the Vaisyas, who provide the food, clothing, and other necessities of man, born of the belly of the god; and the Sudras, whose lot is servitude and issue from his feet. The first three are 'twice born' and wear the sacred thread, though the Vaisyas receive it only on marriage. All Hindus belong to one or other of these four original castes or classes. Though similar to classes which once existed in Persia, Egypt, and Arabia, they survived in India only. It is suggested that the caste system was inaugurated as a method of securing stability at a time of social upheaval, such as would have occurred when the rulers of the Aryans entered India after being expelled by force from their earlier home. That the caste system did achieve such stability is shown by the tenacity with which Hindus cling to it while exhibiting apathy to all forms of government and changes in it. The formation of new castes strengthens the bonds of caste, for all are equally a manifestation of Brahma, though of different qualities.

Manchurian Rodents and Disease.—In the steppes of Asia rodents play a significant part in the web of Nature, mainly on account of their enormous powers of multiplication. The tunnelling of underground burrows, the destruction of vegetation, and the tilling of the soil are all important activities, but for man their most vital part is that of possible disease carriers. It is undoubted that the sudden vanishing of many rodent plagues is due to epizootics, and many substantial reasons suggest that the epizootics occurring among the rodents of the steppes are associated with the spread of bubonic plague, which visits the region almost every year. With this possible association in view, Dr. Wu Lien Teh, chief of the Manchurian Plague Prevention Service, Harbin, has published a useful account of the biology and pathology of the wild rodents found in Manchuria and Mongolia (*Bull. Pekin Soc. Nat. Hist.*, vol. 4, No. 2, p. 95, December 1929). Several of the rodents, such as the tarabagan (*Arctomys bobac*), the spring hares (*Alactaga* and *Dipodipus*), various voles, rats, and mice, have already been found to be susceptible to plague under natural conditions. Moreover, by harbouring plague during hibernation, some carry over infection from one plague season to another. It has been shown that domestic rats play an important part in the spread of the plague outbreaks, and attention is now being turned to the investigation of the source of the domestic rat infection, whether or not it may be connected with wild rodents.

Fluctuations of Manitoban Grouse.—For several species of animals it has now been shown that numbers fluctuate with a fairly regular rhythm, although the periodicity appears not to be identical for all species. To the growing list of regular fluctuations Norman Criddle would add the sharp-tailed grouse and ruffed grouse in Manitoba (*Canadian Naturalist*, April, p. 77, 1930). The years of plenty of these he associates with abundant locust years, and traces the relationship through the fact that grasshoppers are apparently necessary food for the young of the grouse. The reduction in numbers which follows years of abundance he suspects may be due partly to disease and perhaps partly to the activities of enemies, such as goshawks. But has the author proved his point about periodicity at all? His observations from 1914 to 1929 on the numbers of ruffed grouse nesting upon a 26 acre wood lot clearly do not establish a rhythm, for if a rhythm exists, it approaches a ten-yearly period, and the observations cover only sixteen years. On the other hand, the graph showing the annual fluctuations of grasshoppers, sharp-tailed and ruffed grouse from 1895 to 1929 at Aweme, Manitoba, looks convincing with its three series of peaks occurring at intervals of ten years. But the figures upon which this interesting graph is based are not stated, and we are left to understand that it represents no more than an ideal representation of the general notes in a series of journals, and therefore, that its details and fine agreements have no numerical sanction. More should have been said about the character of the information upon which the graph and consequently the conclusions are based.

Rooting of Woody Cuttings—Very contrary reports have been given by different investigators as to the effect of the buds upon the production of roots on hardwood cuttings Van der Lek has recently described experiments which suggest that in willow, currant, and vine the production of roots is more rapid upon such cuttings when the buds are left upon them He suggested that 'hormones' released from the developing buds might be responsible for this effect W A Sledge points out, in a paper in the *Journal of Pomology*, Vol 8, No 1, January 1930, that root production in such cuttings is closely connected with cambial activity He re examines root production in cuttings from this point of view and confirms an early observation of Hartig that cambial activity begins on the shoots at the base of the buds and works from thence down the stem In these cuttings, however, cambial activity is also resumed at the base of the cutting as the result of the wound, such cambial activity being quite independent of the presence of buds, as is shown by an examination of internodal cuttings, in which also cambial activity occurs at the proximal end of the isolated internode Root production seems certainly associated with this renewal of cambial activity and the effect of the buds in enhancing root production in Van der Lek's experiments may be associated with the renewed activity of the cambium throughout the length of the cutting as the result of the early development of the buds

Radioactivity of Granites and Granodiorites—Dr H Hirschi has recently published in the *Schweiz Min und Pet Mitt* determinations of the radioactive elements in three important groups of plutonic igneous rocks The results are summarised in the table below, the detailed references being as follows (1) "Radioaktivität der wichtigsten Granitmassen des Gotthardmassivs" Bd 8, Heft 2, 318 320, 1928 (2) "Radioaktivität des Albtal und Schlossberg Granits des sudlichen Schwarzwaldes" Bd 8, Heft 2, 321 322, 1928 (3) "Radioaktivität einiger Tiefengesteine vom nordlichen Baja California" (Mexico) Bd 9, Heft 1, 1 2, 1929

Ref	Rocks and Localities	Per gm of Rock		
		U($\times 10^{-6}$)	Th($\times 10^{-6}$)	K($\times 10^{-2}$)
1	*St Gotthard Massif*			
	Gamsboden Granite gneiss	1 77	4 1	4 68
	Rotondo Granite	1 41	6 5	5 29
	Fibbia Granite	0 92		4 84
	Kristallina Granite	1 20	4 3	4 78
	Medelser Granite	0 74	3 4	5 18
2	*Southern Black Forest*			
	Albtal Granite	1 32	4 4	5 03
	Schlossberg Granite	1 32	4 2	6 10
3	*Northern Lower California (Mexico)*			
	Granodiorite	0 28	2 5	1 91
	Granodiorite	0 24	1 7	2 32
	Granodiorite (border facies)	0 41	1 5	2 75
	Biotite hornblende quartz diorite	0 25		2 95
	Granodiorite	0 37	2 2	
	Biotite granite	0 63	1 5	4 96
	Granodiorite	0 60	1 7	2 92
	Hornblende granite	0 64	7 0	3 05
	Norite gabbro	0 30	3 2	0 25
	Biotite hornblende granite	0 78	4 8	3 88
	Granodiorite—quartz diorite	0 31	4 4	2 41
	Granodiorite	1 23	4 5	2 06

The Golconda Diamond Mines—The first issue of the newly established *Journal of the Hyderabad Geological Survey* contains the annual report of the Survey, but is mainly devoted to a geological and historical account by Capt L Munn of the ancient diamond mines of Hyderabad, Golconda was formerly the capital of this State Capt Munn's compilation is supplemented, through the courtesy of the Royal Society, by a reprint of a paper on the subject read before the Society by the Earl Marshal of England in 1677 Up to the year 1728, this region was the sole source of the world's supply of diamonds, the Great Mogul or Koh i noor being among the more famous of the later finds The earlier wealth has become proverbial and was responsible for the fabulous tales of Sindbad the Sailor and Marco Polo The diamonds are found in the Pre Cambrian Banaganpilly Group of quartzites and pebble beds occupying a low position in the Vindhyan system, and it is noteworthy that at Wajra Karur "an igneous pipe, or neck, of bluish tuff like rock exists" No gems have been extracted from this pipe and the real source is probably hidden beneath the Deccan traps In 1890 a modern attempt to exploit the 'mines' was made, and 3444 stones were extracted before the enterprise was closed down in 1894 as being unprofitable

Silica Glass at Meteor Crater—A remarkable occurrence of lechatelierite or silica glass produced by the fusion of a saccharoidal sandstone at the bottom of the depression of Meteor Crater in Arizona is described by A F Rogers in the *Am Jour Science*, March, 1930 The only rocks in the immediate neighbourhood are sandstones, shales, and limestones, the nearest exposed igneous rocks being ten miles away A temperature of between 1400° and 1800° C was required to transform the quartz into silica glass The latter occurs in comparatively large masses up to 15 cm in thickness and could not have been formed, like fulgurites, by lightning It is equally impossible that silica glass could be produced by a steam explosion Barringer's well known hypothesis that the crater was formed by the impact of a huge meteorite thus receives strong support, for no other explanation has been advanced that would equally well account for the melting of some parts of the sandstone floor and the shattering of other parts into a finely comminuted rock flour

A 100-Ton Testing Machine—In the *Engineer* for April 4 is an illustrated description of a new 100 ton electrically operated testing machine, which has been supplied by W and T Avery, Ltd, to the City of Leicester Colleges of Art and Technology The machine is of the compound lever type For tension tests it will take specimens up to 10 ft in length and 3 in in diameter, for compression tests, specimens 10 ft in length and up to 12 in square, and for bending tests specimens from 4 ft to 14 ft can be accommodated with a maximum width of 16 in The straining crosshead is moved by three straining screws on the end of each of which is a spur wheel driven by a main worm reduction gear which in turn is coupled to a gear box driven by a reversible variable speed electric motor The crosshead can be moved at speeds varying from $\frac{1}{10}$ in to 8 in per minute The scale on the steelyard is machine engraved from zero to 100 tons by divisions of 1 ton, and a micrometer screw dial subdivides these readings into $\frac{1}{100}$th ton divisions Mounted on the top of the steelyard column is an autographic recorder

Quantitative Analysis by X-Rays—The April number of the *Proceedings of the Royal Society* contains a paper by C E Eddy and T. H Laby on the quantitative analysis of alloys by means of their X ray emission spectra (see also NATURE, April 5, p 524) The fundamental assumption made is that the ratio of the number of atoms of two elements in an alloy

is equal to the ratio of the intensities of corresponding lines in the X ray spectra of the elements, provided that the lines are excited under equivalent conditions, and that the elements are nearly equal in atomic number The experimental determination of the relative intensities of the lines is made by making the alloy the target of an X ray bulb, and analysing its emission spectrum by a rotating crystal spectrometer with photographic registration, the blackening of the X ray film, as measured by a Moll recording microphotometer, being correlated with the corresponding intensity of the X-rays by the usual methods In general, Prof Laby and Mr Eddy's results are more satisfactory than those of earlier workers in this field They have paid some special attention to alloys in which the element to be estimated is present to the extent of less than one per cent, to which it is often difficult to apply other methods of analysis, especially when only small samples of material are available, and have also obtained good results for traces of lead in zinc, a case in which the elements differ widely in atomic number and for which a modified method had to be devised

Measurements at High Voltages – The amount of power absorbed by the dielectric in an electric cable when working under various conditions is considered by many manufacturers to give valuable information as to the quality of the cable In a paper on low power factor measurements at high voltages, which was read to the Institution of Electrical Engineers on April 4, Dr E H Rayner, W G Standring, and R Davis, of the National Physical Laboratory, give a critical study of the various methods adopted in practice for measuring these dielectric losses When a high voltage is applied to unloaded mains, the ratio of the power absorbed to the product of the volts and amperes, that is, the power factor, is generally very minute In this case the measurement of power presents many difficulties, as a small difference in the phase angle between the current and the pressure may make a large difference in the power measured A standard air condenser, the difference between the plates of which is variable, has been constructed It is suitable for use with 100 kilovolts When the distance between the plates is 10 cm, the capacity, or, as it is now called, the capacitance, is 500 c g s units This condenser, when used with a Schering bridge, is found to give very accurate results When using wattmeter methods of measurement, it was found that the non inductive resistances or 'resistors' were often affected by stray capacitance currents These errors could be eliminated if the resistor were shielded at every point by an electric field maintained at its own potential The resistor used consisted of water flowing in tubes, and these were surrounded by others at the same potential It was found possible by this compensation to keep the electric current in the water in phase with the applied voltage Compared, however, with the air condenser, a resistor using a closed water circuit was relatively a troublesome piece of apparatus to use During the experiments, the resistivity of the water was well maintained at 30,000 ohms for four months

Carbonisation Tests —It is frequently important to be able to estimate the value of a coal for carbonisation purposes by tests which can be carried out in the laboratory All such tests exhibit the defect that large scale results cannot be exactly reproduced, and certain factors are necessary to correlate these with laboratory results The Gray King assay was devised at the Fuel Research Station for the evaluation of coal for purposes of carbonisation at low temperatures —600°—and the appropriate correlation has already been made In *Fuel Research Technical Paper*, 24 (H M S O 1930, 9*d* net), an account is given of a modification of the assay whereby higher temperatures are used and conditions conducive to secondary decomposition in the retort are provided Factors which enable the results obtained with this new apparatus to be interpreted in terms of gas works carbonisation have been determined

Fires in Bunkers and Cargo Coal —The transport of coal by sea is fraught with a serious hazard of fire which continues to take a heavy toll in spite of generations of experience, and although radio communication has removed the worst terrors The hazard has been the subject of repeated inquiry, and again, recently, by the Fuel Research Board, which has investigated 336 fires in bunkers and cargo coal in 272 ships (*Fuel Research Special Report*, No 5, London H M Stationery Office 2s) The net result of this inquiry is that 86 per cent of these fires could be assigned to definite and ascertainable causes, avoidable by suitable precautions Only 14 per cent of the accidents were so unaccountable as to leave unavoidable spontaneous combustion as the only assignable cause All fuel is liable to spontaneous combustion under certain conditions which coal chemistry has brought to light, and it seems that this fire loss is one which could almost be avoided by the application of existing knowledge Shipbuilders might remove hot pipes and other sources of heat from bunkers or holds and design ventilation systems so as to avoid leading air into large masses of coal in confined spaces Shipowners might maintain bulkheads sound and tight Certain precautions might be taken at coal staithes in the loading and trimming of coal In short, a little scientific knowledge might leaven the practice of coal handling and, to judge from this report, a handsome dividend should accrue to both shipowners and underwriters

Utilisation of Salt-Lake Deposits —The great mineral wealth which is available in the form of salt lake deposits in various lands has up to the present, been very incompletely utilised, except for the extraction of ordinary salt Prof B Panteleymonoff, of the Academy of Sciences in the Ukraine, contributes an article to the *Chemiker Zeitung* of Feb 22 on the progress which has been made since 1923 in the exploitation of Russian salt lake deposits at the Rapa works The article is written exclusively from the industrial point of view, and is not concerned with the great mass of purely scientific work which has already been carried out there Among the problems investigated on the technical side is the production of compounds of magnesium and halogens The magnesia obtained is of a high degree of purity Iodine appears to be confined to those lakes which are in the neighbourhood of petroleum deposits, and the problem of its satisfactory extraction has not been completely solved The possibility of the early exhaustion of the iodate deposits in Chile lends interest to this problem Magnesium chloride is perhaps the most important of the products obtained, owing to the fact that its extraction leads up to the production of potassium chloride and magnesium sulphate from the mother liquors The extraction of magnesium chloride from salt lake deposits is a more difficult problem than that of its production as a by product of the Stassfurt deposits Bromine is either extracted with a solvent or recovered by distillation The systematic design and development of undertakings for the utilisation of these deposits is of exceptional interest not only in Russia but also in America, France, Italy, and other countries which possess salt mines

The Unsaponifiable Fraction of Certain Oils

IN attempting to concentrate the fat-soluble vitamins, investigators submitted the fats or oils containing them to saponification, and found that they passed unchanged into the unsaponifiable fraction Subsequent work, especially in connexion with vitamin A, has led to increased knowledge of the constituents of this fraction of a number of natural oils and fats, although the identification of the vitamin itself has not been successful At the same time a certain amount of attention has been directed to the physiological functions of some of these constituents It may be of interest to review briefly some of the more recent work on this subject

FISH OILS CHEMISTRY

It is only natural that the unsaponifiable matter of cod liver oil should have been thoroughly investigated, considering its importance as a source of supply of vitamins A and D, much attention has been devoted to it, especially in Great Britain and Japan Its content of unsaponifiable matter is, however, only small, about 0 7 per cent of the oil, and half of this consists of cholesterol In the other portion, Drummond and his colleagues have identified small amounts of squalene $C_{30}H_{50}$, and batyl alcohol $C_{21}H_{44}O_3$ they also found a small quantity of a hydrocarbon (unidentified), but considered that the main constituents are one or more unsaturated alcohols, possibly oleyl or selachyl alcohols (J C Drummond, H J Channon, and K H Coward, *Biochem J*, vol 19, p 1047, 1925, J C Drummond and L C Baker, *ibid*, vol 23, p 274, 1929) Nakamiya and Kawakami (*Scient Papers, Inst Chem Phys Res*, vol 7, p 121, 1927) claim to have isolated, amongst other products after the hydrogenation of the cod liver oil concentrate, nonacosane $C_{29}H_{60}$ and batyl alcohol, but the identified compounds constitute only a small portion of the whole They were, however, unable to detect squalene in their samples of cod liver oil Weidemann considers that the alcohols present are more unsaturated than selachyl alcohol (*Biochem J*, vol 20, p 685, 1926)

Certain other fish liver oils contain larger amounts of unsaponifiable matter, which is more easily fractionated than that obtained from cod liver oil That from the Greenland shark has been investigated by, amongst others, Drummond and Baker (loc cit) and Weidemann (loc cit) It contains about 15 per cent, of which cholesterol constitutes only about 14 per cent Squalene is present in minute amounts (0 5 per cent of the unsaponifiable matter), the rest of this fraction consists chiefly of batyl (about 20 per cent), selachyl ($C_{21}H_{42}O_3$) and oleyl ($C_{18}H_{35}OH$) alcohols The presence of the last two was indicated by the detection of batyl, and probably octadecyl, alcohols after hydrogenation

The liver oil of the Japanese shark contains about 5 per cent unsaponifiable matter Small amounts of cholesterol and possibly squalene were detected, chimyl alcohol ($C_{19}H_{40}O_3$) is present to the extent of about 20 per cent, whilst the rest of the fraction is composed chiefly of selachyl alcohol

Drummond and Baker reduced chimyl alcohol with hydriodic acid and obtained cetyl iodide and isopropyl iodide their results indicated that the alcohol is a monoglyceryl ether of cetyl alcohol Heilbron and Owen have shown that batyl alcohol is an ether of octadecyl alcohol and glycerol, it probably has the formula $CH_3 (CH_2)_{17} O CH (CH_2OH)_2$, since it is optically inactive (Drummond, *Chem and Ind*, vol 49, p 1, T, 1930)

The hydrocarbon squalene contains six double bonds, it forms a characteristic hexahydrochloride by which it can be easily identified Channon has investigated its distribution in certain fish, and found it to be present in the liver oils of only three members of the Squalidæ family it has, however, also been found in the livers of certain Japanese elasmobranchs (*Biochem J*, vol 22, p 51, 1928) It seems unlikely that it can be derived from the food, in any case it was not found in the samples of plankton examined The unsaponifiable matter of the liver oils of these fish formed a very high proportion of the oil, 67 73 per cent, other fish contained up to 33 per cent In general the unsaponifiable fraction was considerably greater than in mammalian livers It was noticed that in the Selachii there was an inverse relationship between the amount of unsaponifiable matter present and its sterol content, independent of whether squalene was present or not There appears to be no relationship between the sterol and squalene

FISH OILS PHYSIOLOGY

Channon has investigated the results of administering certain of these higher alcohols and squalene to mammals He found that rats absorbed a certain amount of the latter when fed in daily doses not exceeding 0 075 c c a day or mixed to the extent of 1 per cent in the diet In some of the experiments the fæces were collected during their course and worked up at the end with the livers and bodies of the animals, in others, only the livers were examined for the presence of squalene (*Biochem J*, vol 20, p 400, 1926) The fæces were extracted with alcohol and ether, and the extract then treated as the other material Saponification was followed by ether extraction of the unsaponifiable matter, which was again saponified and the solution extracted with ether Cholesterol was removed with digitonin and the mother liquors extracted with ether The residue, after removal of the solvent, was again dissolved in ether, and dry hydrochloric acid gas passed through the solution The squalene hexahydrochloride so obtained was recrystallised from acetone In one experiment, 2 77 gm squalene were given to each rat over a period of 6 weeks, 1 7 gm was excreted The unsaponifiable matter in the liver was increased up to 2½ times that in the controls on the same diet and was half as much again in the carcass (without liver) The cholesterol content in the liver was doubled The squalene actually recovered from the liver, however, only accounted for about half of the unsaponifiable matter left after removal of the cholesterol The increase in the cholesterol with increase in the total unsaponifiable matter is the reverse of the relationship found in the fish oils mentioned above

In further experiments with Collinson (*Biochem J*, vol 22, p 391, 1928) it was found that rats absorbed about 0 045 gm daily of oleyl alcohol and phytol, 0 03 gm up to 0 09 gm of cetyl alcohol, and 0 017 gm of cholesterol the two latter were given in dispersion in olive oil Phytol appeared to be more readily absorbed than oleyl alcohol These two increased the amount of unsaponifiable matter in the liver, and at the same time the cholesterol content was raised Cetyl alcohol had no influence upon this fraction of the liver fat The administration of cholesterol increased it four times, and the whole of this increase was accounted for by the deposition in the organ of cholesterol itself It was also observed that the solubilities of these alcohols in bile follow the same order as the degrees to which they are absorbed From some experiments of Mellanby with emulsified fat and squalene, it appears that particulate absorp-

tion of fatty substances may occur in the intestine, but only in the presence of bile

These results led to a re examination of the question as to whether liquid paraffin can be absorbed from the gut, rats and a pig were used (Channon and Collinson, *ibid*, vol 23, p 676, 1929) Reliance was placed on the iodine value of the unsaponifiable fraction of the liver, together with an estimation of its cholesterol content to determine the presence of paraffin in this organ The rats were given 5 per cent paraffin in the diet for five weeks, the pig 100 c c daily, mixed with gum acacia mucilage and a little food, for about eight weeks The unsaponifiable matter in the livers of the paraffin fed rats was increased 40 per cent, the cholesterol percentage was reduced, but the absolute amount was unchanged as compared with the controls, the iodine value of the non sterol fraction was 31 instead of 119 Similar results were obtained in the case of the pig, in addition, a saturated hydrocarbon was actually isolated The non sterol fraction (expressed as a percentage of the liver weight) was increased $3\frac{1}{2}$ times in the rats and $2\frac{1}{2}$ times in the pig, but its iodine value in the latter was decreased to a third of that of the control

MAMMALIAN OILS AND FATS

Channon and Marrian have found an unsaturated hydrocarbon in mammalian liver, which is probably not squalene, although closely allied to it (*Biochem J*, vol 20, p 409, 1926) The unsaponifiable material was prepared from the livers of the pig, sheep, ox, horse, and man, the yields were 0 3 0 4 per cent More than half of the material consisted of cholesterol, and pigments were also present The hydrocarbon was obtained as a crystalline hydrochloride or an amorphous bromide, both of which are insoluble in ether, whereas the cholesterol compounds are soluble, by use of either method the hydrocarbon can be separated from the latter Considerable purification was effected by making use of the fact that the hydrocarbon is insoluble in methyl alcohol, but it was not obtained in the pure state It could not be distilled at 2 mm Hg pressure, decomposition occurring The hydrochloride and bromide were analysed, but molecular weight determinations could not be carried out, since the hydrocarbon was not prepared in the pure state, and the salts are very insoluble and decompose at high temperatures No squalene was found in these livers The same hydrocarbon has also been detected by Drummond and Baker (loc cit) in sheep liver fat

Certain members of the petrel family store in their stomachs an oil, to which attention has been directed from the fact that it contains vitamins A and D Rosenheim and Webster have examined the stomach oil of the fulmar petrel, which breeds on St Kilda (*Biochem J*, vol 21, p 111, 1927) It was found that the oil is a liquid wax containing nearly 40 per cent of unsaponifiable matter, unsaturated higher alcohols and clupanodonic acid were found to be present, but there was only a small amount of glycerol, cetyl alcohol was not detected In many respects the oil resembles sperm oil The authors suggest that the bird uses the oil as a preening material Both vitamins A and D were present

Leigh Clare has also found vitamin D in the stomach oil of the Australian petrel or 'mutton bird' (*ibid*, vol 21, p 725, 1927) Carter and Malcolm have also carried out investigations on mutton-bird oil (*ibid*, vol 21, p 484, 1927) They consider that it consists largely of cetyl oleate together with esters of related alcohols and acids, it contains only traces of glycerol and little cholesterol The origin of the oil is obscure Experiments indicated that it could be digested *in vitro* by pig's pancreatic lipase, and that small amounts could be absorbed by the cat or the rat, cetyl alcohol in olive oil was also absorbed by the latter animal, a result which was confirmed later by Channon and Collinson, as mentioned above Carter and Malcolm suggest that the presence of the oil in the stomach may be accidental, and that it is the tail gland secretion which has been swallowed

ETHER SOLUBLE SUBSTANCES IN PLANTS

Channon and Chibnall have investgated the ether-soluble substances of cabbage leaf cytoplasm (*Biochem J*, vol 21, pp 225, 233, 479, 1112, 1927 vol 23, pp 168 and 176, 1929) The material was prepared by mincing the leaves with water and squeezing through silk, the filtrate was then heated to 70°, when the cytoplasm was coagulated, and could be collected and pressed to free from excess water The dried material was powdered and extracted with ether From a third to a half of the total cytoplasm was extracted from the leaf, the ratio of the protein to the ether soluble substances present is 3 to 1 The total amount of the latter in the leaf cytoplasm is about 3 5 per cent of the total leaf solids Further fractionation was obtained by the use of solvents, soluble in acetone ether but insoluble in light petroleum are the pigments, chlorophyll 9 3 per cent, carotin 0 5 per cent, and xanthophyll 0 8 per cent of the total ether soluble material, soluble in ether acetone and light petroleum, the glycerides and waxes—the fatty acids accounting for 17 5 per cent and glycerol for 1 3 per cent, and unsaturated unsaponifiable matter consisting of sterols 4 5 per cent, and unidentified compounds, probably alcohols and hydrocarbons 13 3 per cent The fraction insoluble in ether acetone could be subdivided into a fraction insoluble in hot acetone — calcium phosphatidate 18 4 per cent, unidentified calcium salts, possibly of fatty acids and phosphoric acid 5 0 per cent, and an unidentified iron compound 3 0 per cent, and a fraction soluble in hot acetone, the saturated unsaponifiable matter consisting chiefly of nonacosane and di n tetradecyl ketone, 12 3 per cent There is an apparent loss of 14 per cent during the fractionations the greater part of which is due to mechanical working losses, but it is possible that 5 per cent represents some other compounds, possibly hydroxyacids

In the glyceride fraction, the results obtained suggested that palmitic, stearic, linolenic, and linolic acids were present, and possibly oleic acid also, palmitic accounted for two thirds of the saturated acids and stearic for the remainder The yield of fatty acids was higher in winter cabbage, that of the saturated unsaponifiable matter lower in winter than in summer

Considerable attention was directed to the phosphatides, little if any phospholipin was detected, the major part of the ether soluble phosphorus being present in the form of the calcium salt of a diglyceride phosphoric acid The free acid and its lead salt were prepared, and barium glycerophosphate was also made from the former The fatty acids present in the molecule appear to be stearic, palmitic, linolenic, linolic, or possibly oleic The greater part of the acids in the molecule is unsaturated, whereas in lecithin and kephalin saturated and unsaturated acids are present in equimolecular proportions The authors consider that phosphatidic acid may be a precursor of the lecithin and kephalin found in animal tissues rather than an *in vitro* decomposition product There is already evidence in existence that calcium can be extracted from tissues with the kephalin fraction The acid is a brownish oil, soluble in organic solvents, slightly soluble in water, the sodium salt is soluble in water, slightly soluble in cold alcohol, and insoluble

in ether, the barium, calcium, and lead salts are insoluble in water, acetone, and alcohol, but soluble in ether

Nearly one-half of the phosphatide fraction is soluble in hot acetone After purification by saponification, recrystallisation, and distillation, a material resembling paraffin wax was obtained, but the melting point was indefinite, indicating that it was a mixture By fractional distillation at 0 1 mm pressure and crystallisation from benzene alcohol, the hydrocarbon $C_{29}H_{60}$ was obtained in the pure state The formula was confirmed by X ray analysis The higher boiling fractions from the distillation were treated with hydroxylamine, the ketoxime was separated from the hydrocarbon by means of its greater solubility in light petroleum and acetone, and the ketone finally regenerated by boiling in hydrochloric acid alcohol X ray analysis indicated that it was either $CH_3(CH_2)_{13}CO(CH_2)_{13}CH_3$ or $CH_3(CH_2)_{14}CO(CH_2)_{12}CH_3$, both were accordingly synthesised, when it was found that the substance was di n tetradecyl ketone Nonocosane and the ketone occur in the ratio of 3 to 1 Small quantities of other unidentified substances are also present in this fraction of the cytoplasm

Maclean and her co workers (*Biochem J*, vol 23, pp 107 and 634, 1929) have also isolated from cabbage leaves nonacosane and di n tetradecyl ketone, from spinach leaves, however, the hydrocarbon hentriacontane, $C_{31}H_{64}$, was obtained

In conclusion, it may be mentioned that Maclean has isolated from yeast fat a second sterol which she has named 'zymosterol' The crude sterol was separated, by recrystallisation from alcohol, ether, and acetone, into the less soluble ergosterol, m p 158 5°, and a sterol, m p 108° 109° (zymosterol) (*ibid*, vol 22, p 22, 1928) The latter is dextrorotatory (in ethereal solution), the former lævorotatory (in chloroform) It probably has the same number of ethenoid linkages as ergosterol and a very similar structure, it is precipitated by digitonin, but shows no selective absorption in the ultra violet It cannot be converted into vitamin D by irradiation (*ibid*, p 980)

International Congress of Archæology and Anthropology, Portugal, 1930

READERS of NATURE will have in mind the recent criticisms of the international standing of the congresses in archæology and anthropology which have been held since the War under the auspices of the Institut International d'Anthropologie of Paris These were summarised in the leading article in our issue of Mar 1 In the recently issued announcement of the Congress to be held in Portugal on Sept 21–30 next, it would now appear that the promoters hope to meet objections which have been raised on the ground that the Congress is not truly international in character by indicating that this congress will be a continuation of the older series of the International Congresses in Anthropology and Prehistoric Archæology, of which the last was held at Geneva in 1912 The invitation is issued jointly by the Conseil permanent du Congrès International d'Anthropologie et d'Archéologie Préhistorique and the Institut International d'Anthropologie It is announced as the "xv[e] Congrès International d'Anthropologie et d'Archéologie Préhistorique" and the "iv[e] Session de l'Institut International d'Anthropologie", finally, it is pointed out that the meeting coincides with the fiftieth anniversary of the Congress held in Lisbon in 1880

While welcoming with all good will this expression of the desire of the members of the Institut that the congress should be regarded as truly international, it must be pointed out that it is not sufficient to call it so, or even to announce that it is a continuation of a former congress which has not met for eighteen years The only international element in the organisation is the committee in charge of the preparation of the scientific proceedings, which, it is understood, has no executive power and on which Great Britain is not represented The committees responsible for local arrangements at Coimbra and Oporto naturally are entirely local, but the publications committee is French with two exceptions The real executive of the Congress, we presume, is constituted as before The invitation is issued from the Siège Social of the Institut, namely, the École d'Anthropologie, and not from Lisbon

Of the "Conseil permanent" of the older Congress, M Marcellin Boule is a member of the Comité d'Honneur, and M Pittard represents Switzerland on the committee in charge of the preparation of the scientific proceedings

The Congress will be divided into sections, of which the first will deal with questions of morphological anthropology and functional ethnology, among the points specifically mentioned in this division being the methods of anthropology and especially the interpretation of statistics, the human brain from the racial point of view, endocrinology and human morphology, and the relation between the yellow races of Africa (Bushman) and the yellow races of Asia

The second section will deal with human palæontology and prehistoric archæology, in which the question of the Kitchen midden people of Portugal, Armorica, and Denmark will be discussed Another subject will be the distribution of cereals in neolithic times as well as the origin of domestic animals, particularly the dog

The third section will deal with heredity, eugenics and cognate subjects, including criminology and psycho sociology

The fourth section is of a comprehensive character, covering ethnography, folklore, linguistics, religions, and human geography One topic of discussion specifically mentioned is the geographical and ethnic origin of the Aurignacians Primitive survivals among civilised peoples should give rise to lively discussion

The session will be formally declared open by His Excellency the Minister of Public Instruction, Prof Gustavo C Ramos, on Sept 21, at Coimbra, and a dinner will be given by the Rector of the University on the same day On the following days, after the work of the sections has closed, conversaziones or illustrated lectures will be given in the evening On Sept 26 an archæological excursion will be made to Figueira da Foz on the way to Oporto On Sept 26 the Congress reopens at Oporto, on the evening of which day there will be a folk-lore fête at the Palais du Cristal, and on Sept 27 the Congress will be formally declared closed, a banquet being held afterwards On Sunday a motor expedition of archæological interest will be made to Guimaraes and Citania de Briteiros The Congress will arrive at Lisbon on Monday, Sept 29, at midday A formal reception will be held by His Excellency General Carmona, President of the Portuguese Republic, and the following and final day will be spent in visits to museums and other places of interest

Intimation of intention of attending the Congress and subscriptions should be addressed to le Trésorier de l'Institut International, 15 rue de l'École de Médecine, Paris (6[e])

Lime Requirement of Soil

A SURVEY of the results from liming experiments in progress during the last twenty five years at the Tennessee Agricultural Station was given by Prof C A Mooers in his address as vice president of Section O (Agriculture) of the American Association for the Advancement of Science at the recent Des Moines meeting, and has now appeared in *Science*, vol 71, p 81 The investigations have been carried out in the laboratory in conjunction with open air lysimeters of two types, one containing surface soil only, the other having in addition an under layer of heavy loam subsoil

One of the early discoveries was the fact that silica readily combined with carbonate of lime with the formation of calcium silicate, a form of calcium more suitable for clovers than the carbonate The idea that lime exerts a 'burning' effect on soil humus has been refuted, neither calcium oxide nor hydroxide producing increased oxidation until their conversion into carbonate or silicate, and even then the increase was temporary only As regards base exchange, the generally accepted view that potash is liberated by liming is shown to be erroneous, a normal application of lime actually repressing the leaching of this element

Concerning the relationship between calcium and magnesium, new light has been thrown on many of the older studies Liming with burnt lime or high calcic limestone was found to increase the calcium and depress the magnesium outgo, whereas additions of magnesium had the reverse effect Treatment with a calcium magnesium compound such as dolomite had the same result as the addition of magnesium only, these findings explaining the harmful action of high calcic limes on a magnesium loving plant such as tobacco

The question of the effect of liming on the oxidation of soil sulphur and nitrogen is also discussed, and the availability of added lime shown to decrease with time The chief discovery made at the station, however, is the formation of ternary systems such as $CaO \, Al_2O_3 \, CaSO_4$ by the action of aqueous solutions of calcium hydroxide and sulphate on aluminium complexes Such systems are of low solubility when alkaline, but readily soluble in neutral or acid media The reaction can be used to determine the reactive amount of alumina and silica, and is promising as a method for measuring the colloidal properties of a soil It has already proved invaluable in affording an explanation of the disintegration of concrete under certain conditions which can now be avoided

In conclusion, Prof Mooers emphasises the importance of lysimeter experiments for both the chemist and plant physiologist

Prickly-Pear Control in Australia [1]

THE attempt that is being made to control the prickly pear menace in Australia by biological means is a practical experiment of great interest and importance The initiation and progress of this work has already been referred to in the columns of NATURE, and the most recent report on the subject has lately come to hand

Since the year 1925, the measures taken to combat the scourge have greatly reduced, if not entirely arrested, its yearly spread to uninfested territory The policy of the Prickly Pear Board has been to introduce and acclimatise insects inimical to the growth of all the naturalised species of this plant In carrying out this scheme, the natural enemies of prickly pear in North and South America have been continuously investigated since 1920, and a number of species introduced, under adequate safeguards, into Australia The cochineal insect, *Dactylopius tomentosus*, is now so widely diffused that there is scarcely an area of prickly pear in Queensland or New South Wales which is not infested by this insect The plant sucking bug, *Chelinidia tabulata*, has multiplied and spread in enormous numbers, and the red spider, *Tetranychus opuntiæ*, gives every promise of soon extending throughout the length and breadth of the prickly pear area The moth *Cactoblastis cactorum* is a more recent introduction, about 300,000,000 have been liberated since 1926, and it is believed that within two or three more years it will become general in the desired areas It is estimated that 30 000 acres of prickly pear have been destroyed by this insect in about the last twelve months

In this manner a complex of insect enemies has been established Some species have naturally proved more successful than others, and their combined efforts are already bringing about a considerable measure of control of this pest plant Its reduction is most noticeable in certain scrub areas where it once formed a barrier impenetrable to animals In the heart of the infested country it is now possible to travel for 100 miles without seeing any flourishing plants The production of fruit and new growth has become greatly diminished, fewer seedlings are able to become established, while large clumps of plants are being gradually sapped and destroyed

On present indications, it is reasonable to expect that vast areas of prickly pear will be freed within a few years Too much confidence of complete eradication is to be deprecated, as the problem has not yet been solved, but the future prospects give reasons for optimism The experiment has not yet had a long enough lease to enable an estimate to be made of the possible influence of such factors as varying or extreme fluctuations of climate, disease, and native insect parasites on one or other species in the complex that is being built up Indigenous parasites and predators have indeed turned to some of the introduced insects but, up to the present, the influence they have exerted has not appeared to be great Although such enemies need close observation being kept on their activities, there is no need for premature or undue alarm that they will materially vitiate the good results that are being achieved A D I

[1] "The Progress of the Biological Control of Prickly Pear in Australia" By Allan P Dodd 44 pp Commonwealth Prickly Pear Board, Brisbane 1929

University and Educational Intelligence

CAMBRIDGE —The Cavendish professor has announced that the first course of Scott Lectures will be given by Dr Niels Bohr at the Cavendish Laboratory at 4 45 P M on May 12, 14, and 16. The subject will be "The Principles of Atomic Theory"

OXFORD —Discussion still continues on the proposal to use the sum of £100,000 realised by the Radcliffe Trust for the establishment of an astronomical observatory in South Africa The advocacy of the scheme by Prof H H Turner is criticised by Prof Lindemann on various grounds, he doubts, for example, whether any special benefit would result to Oxford in relation to other centres of astronomical study Moreover, the climate of Oxford is not conspicuously worse than that of Greenwich, Edinburgh, or Cambridge, while even if it be allowed to be unsuitable for 'positional' astronomy, there are many other lines of astronomical and meteorological research which are in need of assistance, and could well

be pursued in Oxford in consonance with the design of the founder of the trust. To this Prof. Turner replies that the scientific activities of Oxford are not, and should not be, confined to the actual precincts of the city; that additional observatories in the southern hemisphere are really needed; and that there may be a danger of undervaluing 'positional' astronomy, which has conspicuously proved its importance, in comparison with the more recent development of astrophysics.

THE Rockefeller Medical Fellowships for the academic year 1930–31 will shortly be awarded by the Medical Research Council, and applications should be lodged with the Council not later than June 1. These Fellowships are provided from a fund with which the Medical Research Council has been entrusted by the Rockefeller Foundation and are awarded to graduates who have had some training in research work in the primary sciences of medicine or in clinical medicine or surgery and are likely to profit by a period of work at a university or other chosen centre in the United States before taking up positions for higher teaching or research in the British Isles. In special circumstances the fellowships may be tenable at centres of research not in America. A fellowship held in America will have the value of not less than £350 a year for a single fellow, with extra allowance for a married fellow. Particulars are obtainable from the Secretary, Medical Research Council, 38 Old Queen Street, Westminster, S.W.1.

THE Salters' Institute of Industrial Chemistry is offering a limited number of fellowships for chemists of post-graduate standing, the object being to afford additional and special training at home and abroad preparatory to a career in industrial chemistry. The normal value of each fellowship is from £250 to £300. Applications must reach the Director of the Institute, Salters' Hall, St. Swithin's Lane, E.C.4, by June 2. The Institute will also, in July, allocate a limited number of grants in aid to young men and women employed in chemical works in or near London who are desirous of fitting themselves for a career in chemical industry. The latest date for the receipt of applications by the Director is June 7.

THE Ministry of Agriculture and Fisheries is offering until June 15 a number of agricultural scholarships for students who propose to take up posts as agricultural organisers, teachers, or lecturers in agriculture; also research scholarships in agricultural and veterinary science. In addition, it is prepared to receive up to May 15 applications for grants in aid of scientific investigations bearing on agriculture to be carried on in connexion with a university, university college, or other approved institution or society in England and Wales. Applications for all of the foregoing should be sent (upon forms A. 472/T.G., 900/T.G., and A. 53/T.G. respectively) to the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1.

DANIEL C. JACKLING, of San Francisco, president of the Utah Copper Company, has made provision for the establishment at the Missouri School of Mines and Metallurgy at Rolla, of which he is a graduate of the class of 1892, of the Jackling Foundation for education in the sciences and arts pertaining to the mineral industry, the purpose of the Foundation being to offer loan funds and provide scholarships and special educational features not ordinarily provided for at State schools. The Foundation may eventually total £120,000. Of this amount £20,000 is to be used as loan funds and the income from the remainder for scholarships and special educational purposes.

Historic Natural Events

May 6, 1915. Thunderstorm.—During the evening a thunderstorm of unusual violence broke over the centre of London. Between 8.30 P.M. and 10 P.M. more than two inches of rain fell over an area bounded by Piccadilly Circus, Euston Road, Shoreditch, and the Strand, the amount reaching 3.00 in. at Holborn and 3.12 in. at New River Head. Practically no rain fell south of the Thames.

May 8, 1663. Thunderstorm and Flood.—Concerning this Pepys wrote (May 15): "Strange were the effects of the late thunder and lightning about a week since at Northampton, coming with great rain, which caused extraordinary floods in a few hours, bearing away bridges, drowning horses, men, and cattle. Two men passing over a bridge on horseback, the arches before and behind them were borne away, and that left which they were upon: but however one of the horses fell over and was drowned. Stacks of faggots carried as high as a steeple, and other dreadful things; which Sir Thomas Crew showed me letters to him about from Mr. Freemantle and others, that it is very true."

May 8, 1902. Great Eruption of Mont Pelée (Martinique).—For two weeks beginning on April 25, the volcano had been active, throwing out columns of ash and steam. About 8 A.M. on May 8, a dark cloud was seen to issue from the volcano. Sweeping down the slope with great velocity, in two minutes it reached Saint Pierre, the chief city in the island. The blast was tornadic in its violence, its heat was withering, and it seems to have been charged with incandescent particles. The whole city was wrecked and, with two exceptions, all its inhabitants were killed, as a rule instantaneously, the number of dead in Sainte Pierre and its suburbs being reckoned at not less than 30,000. The area of complete destruction was a sector about 8 sq. miles in area, and as a rule its boundaries were sharply defined. There was no flow of lava and no large portion of the crater was blown away, though it is estimated that the discharge of solid matter per day was greater than that of the sediment carried down by all the rivers in the world combined. The sound of the explosion was heard at St. Kitts and St. Thomas (210 miles and 350 miles). Brilliant after-glows were observed at Honolulu, Madeira, Slough, Berlin, Bombay, and elsewhere.

May 9, 1818. Drought.—At Trevereux, near Limpsfield, Surrey, it is recorded that after a deluge of rain on May 8, no further rain fell until Sept. 5, being 17 weeks and 1 day, during which all vegetation was completely burnt up.

May 9, 1867. Shower of Hazel Nuts.—On the night of May 9, during a violent rainstorm, a remarkable shower of 'berries' fell in Dublin, on both sides of the river. They were described as having the form of a very small orange, about half an inch in diameter, black in colour, and when cut across seeming as if made of some hard dark brown wood. They fell with such force that even the police were forced to seek shelter. The 'berries' were afterwards identified as hazel nuts which had been partly fossilised in a peat bog. How they came into the air is not known.

May 9, 1877. Chilian Earthquake Sea-waves.—The epicentre of the earthquake lay about 90 miles southwest of Iquique. The sea waves were observed at different places along 2200 miles of the South American Coast. They swept across the Pacific and were recorded in New Zealand (5600 miles), New South Wales (6800 miles), and so far as Japan (8900 miles).

May 9, 1893. Early Season.—The spring and early summer of 1893 were among the earliest on record in

the British Isles "Stimulated by continued heat vegetation of all kinds was forced on rapidly, and without any check worth mentioning, into leaf and flower, and in some cases into fruit, long in advance of its usual time Even in parts of Scotland straw berries were gathered in May and new potatoes and peas ready for use" (Report on the Phenological Observations, p 127) In south west England the greater bindweed was in flower on May 9, five weeks in advance of its usual date, and even in western Scotland it was only two days later The foliage of trees was abundant and well developed, flowering trees and shrubs bloomed with extraordinary freedom In the fields and hedgerows flowers were abundant and followed each other in rapid succession, but the dry and forcing weather weakened the plants them selves and they soon faded Insects were very numer ous, and the swarms of wasps amounted to a plague The earliness of the seasons was maintained into the autumn, and the harvests began everywhere at almost unprecedented dates, but were very poor over most of England

May 9, 1919 Cloud formed by Aeroplane - During a high flight over Germany, the aviator observed that at a height of 26 000 feet a streak of cloud formed behind him This cloud attained a length of about 40 miles, then gradually spread and developed into a typical cirro cumulus cloud, about 3000 feet broad Similar phenomena were repeated on May 11 On both days the weather conditions were inclined to thunder, and it seems probable that the exhaust gases supplied condensation nuclei to the air, thus giving the necessary stimulus to cloud formation

May 10, 1879 Meteorite —During the afternoon a great meteorite fell and burst near Estherville in Iowa The largest fragment recovered weighed more than 400 pounds This is the largest meteorite in America which has been actually observed to fall

Societies and Academies

LONDON

Geological Society, Mar 26 **W Campbell Smith** A classification of some rhyolites, trachytes, and phono lites from part of Kenya Colony, with a note on some associated basaltic rocks Comparison of specimens collected on two expeditions by Prof J W Gregory in 1893 and 1919, previously described by Dr G T Prior (1903) and Miss A T Neilson (1921), supported by some new analyses has led to a revision of the nomenclature —**T N George** *Ambocœlia* Hall and certain similar British Spiriferidæ The British forms do not exhibit the features emphasised by Hall in his description of *Ambocœlia*, in particular, they differ in the surface ornament, in the cardinal process, and in the musculature of the dorsal valve Two new genera, distinguished one from the other by details of ornament and cardinal area, are therefore established for their reception, and it is proposed to create a new subfamily for the reception of *Ambocœlia* and the new genera The later portion of the paper consists of a detailed description of the British species from the Devonian, Carboniferous, and Permian systems Some of these are new

Linnean Society, April 3 —**H Lister** Observa tions on the comparative morphology of the protozoan fauna found in the paunch and reticulum of rumi nants The actual species vary with the geographical environment of the host By using suitable culture media and a specially designed microculture incubator, they have, during the present investigation, been kept alive for longer periods than hitherto The cultures have shown that the bacteria inevitably introduced with the protozoa render the medium acid, and that this proves fatal to them —**H S Holden** Some wound reactions in *Ankyropteris corrugata* The tissues of the fossil fern *Ankyropteris corrugata* show well defined wound reactions In the root these consist of irregularly disposed wedges of meristem and are confined to the cortex In the stem, wounds usually take the form of irregular cortical fissures bordered on either side by a strip of meristem In the petiole, where the wound is superficial, a pad of healing meristem is developed, but, where it is deep seated, the vascular tissues may be involved —**J M Cowan** Botanical exploration through North West Persia A brief survey of the vegetation of Iraq and North West Persia observed on a tour made on behalf of the John Innes Horticultural Institution and Kew Gardens

Optical Society, April 10 **T Smith** Charts for simple two and three thin lens problems A variety of charts can be drawn each of which furnishes complete first order information on systems con structed from two or three thin lenses —**M O Pelton** The lustre of textile fibres is due to a geometrical property of transparent cylindrical filaments with polished surfaces Some of the factors notably double refraction and diffraction which might affect lustre are discussed and a method is suggested for measuring lustre based on the high lights visible on a curved lustrous surface —**W D Wright** A re determination of the mixture curves of the spectrum The paper describes a method that has been de veloped for calculating the sensation curves and mixture curves from an average set of trichromatic coefficients and the standard luminosity curve without recourse to any further experimental data A complete table of colour mixture data is given The practical value of different methods of colori metry and the most desirable primaries for use as reference standards are briefly discussed

DUBLIN

Royal Society, April 2 —**J Joly** The application of gamma radiation to deep seated tumours The applicator operates on the principle of a pseudo focus, formed by the convergence of two inclined gamma ray beams intersecting at the tumour The beams are kept in continual rotation round a vertical axis while at the same time they are carried along a path determined by a template which has been derived from X ray exploration of the tumour The movements are controlled by clockwork, and the whole applicator, in certain cases, may be worn by the patient without serious inconvenience The γ radiation may be derived from radon tubes or radium tubes such as are used in needle radio therapy, some twenty five or thirty such tubes being packed into each radiator —**J Reilly** and **D T McSweeney** A study of the polysaccharides (Pt 2)

GENEVA

Society of Physics and Natural History, Feb 6 —**J Briquet** The number of carpels in the flowers of *Campanula* The character of the trimery and penta mery of the gynæcium plays an important part in the systematics of this genus Now the author has observed that both these arrangements occur in the flowers of *Campanula Medium* It is therefore neces sary to review carefully the behaviour of various species and to modify the diagnoses and analytical tests —**J Briquet** The carpology of the genus *Mantisalca* Cass The author's studies have proved that the genus *Mantisalca* has been erroneously joined to the genus *Centaurea* —**E Briner, J P Lugrin,** and **R Monnier** The action of nitrogen peroxide and of

sulphur dioxide on lime, calcium carbonate and calcium phosphate The study of these reactions has been undertaken methodically with the aid of the technique utilised in the laboratory for work on gases, and it has led to the proof of the attack, in the absence of water, of calcium carbonate by nitrogen peroxide and by sulphur dioxide The reactions differ from those taking place in the presence of water —**L Duparc** and **L Galopin** The phenocrystals and microlites of the plagioclases of the Abyssinian basalts The authors have recognised six types of rocks, aphyric, porphyric felspar, augitic, porphyric, doleritic or ophitic, and finally a tokeite type In the porphyric types the microlites of the mass are more acid than the pheno crystals A difference in the same direction but to a less extent exists also in the augitic and ophitic types —**L Duparc** and **Ch Wakker** The auriferous layers of St Yrieix The authors have studied several deposits of the region now being worked Nearly everywhere traces of workings are found dating from the Roman occupation The auriferous quartz is always found associated with granulites and pegmatites traversing and penetrating the schists At Chom the auriferous quartz forms veins of variable thickness reaching sometimes two to three metres It is also in the form of auriferous quartz veins that it is found at Champvert, la Tournerie, and la Fagassière —**G Ladame** The metalliferous deposits of Mt Chemin, Valais The author distinguishes three groups of deposits, (1) magnetite, (2) marbles (3) fluorspar and galena The magnetite appears to have been worked from the time of the Roman occupation Its mode of formation cannot be specified On the other hand, tho fluorspar and the galena are clearly in veins

Rome

Royal National Academy of the Lincei, Dec 15 —**S Franchi** The Franco Italian border between the Colle del Piccolo S Bernardo and the Colle della Seigne, to the south of Mont Blanc —**E Raimondi** The geodetic curvature on a surface, and Liouville's formula —**L Laboccetta** General method for the construction of Fourier's 'separate functions' and of De La Vallée Poussin's 'characteristic functions' —**G Mazzone-Sangiorgi** The first elements of a new general theory for the motion of waters and other fluids (2) Seven different cases of jets are considered, the results obtained in each instance being in complete accord with those derived from the author's theory —**A de Mira Fernandes** Odographic systems —**A Tonolo** Integration of the Maxwell Hertz electro magnetic equations The author's method of integration, published in 1910, is extended to the more general form of the Maxwell Hertz equations of the electrodynamics of bodies at rest The resulting formulæ, although complex, are simpler than those obtained by Tedone in 1916 —**M Lecat** Relations between the behaviour of a binary system on distillation and the course of the temperature-vapour pressure curves of the components The conditions for determining if any particular binary system is or is not azeotropic are considered —**Remo de Fazi** and **F Monforte** New reaction of aldehydes (4) Acenaphthene and cyclic aldehydes do not form condensation products, although, in presence of concentrated sulphuric acid, they give a characteristic colour reaction If the acenaphthene is converted into acenaphthenone, this condenses with cyclic aldehydes to products which also give the colour reaction general for these aldehydes Guglialmelli and Delmon's view that the coloration is due to condensation products of fluorene is not in accordance with the experimental results —**A Cavinato** New investigations on euclase Euclase from Valle Aurina Analysis of this euclase gives results in agreement with the molecular ratios, SiO_2 R_2O_3 RO H_2O =1 98 1 2 1, and, if constituents present in small proportions are neglected, the formula becomes $HBeAlSiO_5$ Thus the accepted formula, based on Damour's analysis, is confirmed, and that given by Rammelsberg disproved —**Giulia Martinez** Basalt from Cucchiara Zeppara near Guspini (Sardinia) —**G Pupilli** Periodic respiration caused by sympathicotomy —**S Ranzi** Experimental embryology of the cyclostomes —**P Pasquini** Nervous relations of the transplanted eye and olfactory organ in axolotl embryos —**G Pollacci** and **Maria Bergamaschi** Demonstration, by means of dimethylhydroresorcinol, of the formation of formaldehyde in living plants during chlorophyllic photosynthesis Experiments made with water plants in presence of dimethyl dihydroresorcinol ('dimedon') demonstrate the formation of formaldehyde when the conditions necessary for chlorophyllic synthesis, namely, presence of carbon dioxide and chlorophyll and action of light, are fulfilled The dimedon has a narcotic effect on the plants, but does not kill them, since after the experiment the plants are still capable of assimilation —**R Savelli** and **N Soster** Apogamocarpy in *Cucurbita pepo* and *Cucurbita moschata* —**L S Da Rios** Suction fans and rings

Vienna

Academy of Sciences, Jan 23 —**K Morsch** The action of chloral hydrate and hydroxylamine on the isomeric phenylene diamines —**F Holzl**, **R Kugerl**, and **K Rokitansky** The mobility of some ions containing iron (1) Comparison of simple and complex iron salts —**G T Whyburn** (1) Derived continua dividing the plane —(2) A theorem on derived continua of the plane connected in detail —(3) Connected quantities completely dissectible —(4) Undivided elemental quantities from connected point quantities —**L Kober** The distribution of masses on the earth s surface The ratio of the surfaces of continents to oceans is about 1 to 2½ The ratio of the densities of land to sea is about 2½ to 1 Surface and density of continents and oceans are reciprocally proportional Assuming heights of continents equal to depths of oceans, then the weight of the continents is equal to the weight of the oceans —**F Machatschek** Remarks on the question of the distribution of masses on the earth's surface The ratios just quoted are changed if the continental shelf is reckoned with the continents

Jan 30 —**A Sommerfeld** The paramagnetic forces of the rare earths —**E Beutel** and **A Kutzelnigg** Contributions to analysis of luminescence (1) —**G Lock** Derivatives of phenyl ether (1) Mono nitro, amino and oxy derivatives —**K Beaucourt** Constituents of resin (2) Dehydrogenation of boswellinic acid By the action of selenium or palladium on incense resin, a mixture of aromatic hydrocarbons is produced —**T Pintner** *Tetrarhynchus* from Pacific Grove, Cal, U S A —**H Hornich** The characteristics of connexion *im grossen* and *im kleinen* —**A Rollett** and **O Schneider** Resins and resinous substances (7) Tolubalsam —**F Morton** Report on a botanical expedition to Guatemala, 1928–29

Feb 6 —**R Janoschek** Strata sequence and stratification of the Miocene of Ritzing Burgenland —**O Kühn** The Danic stage in the Alps and Carpathians —**L Waagen** The geological structure of the Eichkogel near Rein, not far from Graz —**O Gugenberger** The Cardita strata in Middle Carinthia and their fauna (1) Brachiopoda

Feb 13 —**K Menger** The introduction of complex numbers into general metrics —**P Gross** and **K Schwarz** Salting out —**K Federhofer** Kinetostatics of systems moving on surfaces

Official Publications Received

BRITISH

Reports of the Imperial Economic Committee Fourteenth Report A Survey of the Trade in Rubber Manufactured Goods Pp 119 (London H M Stationery Office) 6d net

The Journal of the Royal Anthropological Institute of Great Britain and Ireland Vol 59, July to December 1929 Pp xli+278 581+17+48 (London) 15s net

Journal of the Indian Institute of Science Vol 13A Part 2 Formation of Heterocyclic Compounds from Ethyl Carbethoxythiocarbamate By Praphulla Chandra Guha and Shanker Rao A Saletore Pp 11 20 10 annas Vol 13A Part 3 Petrol Water Emulsions By C Varadhan and H E Watson Pp 21 30 12 annas Vol. 13A, Part 4 Studies on Dextrins Part 1 Action of Amylase from Cholam (*Sorghum vulgare*) on Potato Starch by Vinayak Narayan Patwardhan ii Amylase from Ragi (*Eleusine coracana*), by V N Patwardhan and Nuggehalli Narayana Pp 31 41 12 annas (Bangalore)

Southern Rhodesia Report of the Director, Geological Survey for the Year 1929 Pp 10 (Salisbury S R)

The Proceedings of the Physical Society Vol 42, Part 3, No 233 April 15 Pp iv+158 292 (London) 7s net

Canada Department of Mines Mines Branch Mica By H S Spence (No 701) Pp ix+142+21 plates (Ottawa F A Acland) 30 cents

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1268 (Ae 414) Experiments relating to the Flow in the Boundary Layer of an Airship Model By F G Simmons (T 2768) Pp 7+6 plates (London H M Stationery Office) 6d net

Journal of the Royal Microscopical Society Series 3, Vol 50 Part 1 March Pp xvi+100 (London) 10s net

Reports of the Progress of Applied Chemistry Issued by the Society of Chemical Industry Vol 14, 1929 Pp 775 (London) 7s 6d to Members 12s 6d to non Members

Memoirs of the Geological Survey of India Vol 54 The Geology of North Singhbhum including parts of Ranchi and Manbhum Districts By Dr J A Dunn Pp ii+iii+166+xxvii (Calcutta Government of India Central Publication Branch) 12 4 rupees 20s

Report of the Kodaikanal Observatory for the Year 1929 Pp 4 (Calcutta Government of India Central Publication Branch) 6 annas

The Journal of the Institution of Electrical Engineers Vol 68 No 400 April Pp 413 541+xxviii (London E and F N Spon, Ltd) 10s 6d

Imperial Institute Annual Report 1929 by the Director Lieut Gen Sir William Furse to the Board of Directors (Meeting 9th April 1930) Pp 56+4 plates (London)

Department of Scientific and Industrial Research Index to the Literature of Food Investigation Vol 1, No 2 September 1929 Compiled by Agnes Elisabeth Glennie Pp iv+104 (London H M Stationery Office) 2s net

The Scientific Proceedings of the Royal Dublin Society Vol 19 (N S), No 37 The Application of Gamma Radiation to Deep seated Tumours By Dr J Joly Pp 447 450 6d Vol 19 (N S) No 39 Some Geochemical Applications of Measurements of Hydrogen Ion Concentration By Dr W R G Atkins Pp 455 460 6d (Dublin Hodges Figgis and Co London Williams and Norgate Ltd)

Legislative Assembly, New South Wales Report of the Director General of Public Health New South Wales for the Year 1928 presented by the Minister for Health Pp v+126 (Sydney Alfred James Kent)

New South Wales Department of Mines Geological Survey Mineral Resources No 35 The Yanandera Silver Field By L F Harper Pp 68+26 plates (Sydney Alfred James Kent)

Collected Papers from the Science Laboratories of the University of Melbourne 1910-1928 Vol 3 37 papers Vol 4 47 papers Vol 5 42 papers Vol 6 62 papers (Melbourne)

Department of Scientific and Industrial Research Building Science Abstracts Vol 3 (New Series), No 3, March Abstracts Nos 458 670 Pp 73 112 (London H M Stationery Office) 9d net

Department of Scientific and Industrial Research Second Report of the Fabrics Co ordination Research Committee Pp viii+180 (London H M Stationery Office) 5s net

FOREIGN

Publications of the United States Naval Observatory Second Series Vol 12 Pp ix+592+15 plates (Washington D C Government Printing Office)

Bergens Museum Årsberetning 1928-1929 Pp 114 Bergens Museums Årbok 1929 Naturvidenskapelig rekke Hefte 2 Pp 10+22+6+4+8+35+7+48+92+4 Bergens Museums Årbok 1930 Naturvidenskapelig rekke Hefte 1 Pp 179 (Bergen A S John Griegs Boktrykkeri)

Conseil Permanent International pour l'Exploration de la Mer Journal du Conseil Vol 5, No 1, Avril Pp 137 (Copenhague Andr Fred Høst et fils)

Bulletin of the American Museum of Natural History Vol 61 Art 1 Pug Headedness in the Striped Sea Bass, *Roccus lineatus*, and in other related Fishes By E W Gudger Pp 19+8 plates (New York)

The Observatory of Zi ka wei Fifty Years of Scientific Work By the Rev P Lejay Pp 36 (Zi ka-wei)

Japanese Journal of Physics Transactions and Abstracts Vol 5, No 3 Pp 103 137+25-52+ii Vol 5 No 4 Pp 139 160+53 68+vi (Tokyo National Research Council of Japan)

Agricultural Experiment Station Michigan State College of Agriculture and Applied Science. Special Bulletin No 194 The Use of Peat in the Greenhouse By Alex Laurie Pp 28. Circular Bulletin No 129 Results of a Long Time Mineral Feeding Experiment with Dairy Cattle By C F Huffman and O E Reed Pp 11 (East Lansing, Mich)

Smithsonian Institution United States National Museum Contributions from the United States National Herbarium Vol 26, Part 5 Notes on certain Type Specimens of American Asteraceae in European Herbaria By S. F Blake Pp. iii+227 263+v ix (Washington, D C Government Printing Office) 10 cents

Proceedings of the United States National Museum Vol 76 Art 7 *Briarosaccus callosus* a new Genus and new Species of a Rhizocephalan Parasite of *Lithodes agassizii* Smith By H Boschma (No 2804) Pp 8 Vol 77 Art 7 The Caudal Molt of certain Coraciiform Colliform and Piciform Birds By Herbert Friedmann (No 2830) Pp. 6 (Washington, D C Government Printing Office)

Conseil Permanent International pour l'Exploration de la Mer Faune ichthyologique de l'Atlantique nord Publiée sous la direction de Prof Joubin Pl 46 (24 planches). (Copenhague Andr Fred Høst et fils) 4 kr

Proceedings of the Imperial Academy Vol 6 No 1 January Pp iii+25 Vol 6 No 2 February Pp viii+27 ?? (Tokyo)

Report of the Aeronautical Research Institute Tokyo Imperial University No 58 On the Resistance experienced by a Cylinder moving in a Channel of Finite Breadth By Susumu Tomotika Pp 101 142 (Tokyo Koseikai Publishing House) 0 44 yen

Académie Tchèque des Sciences (Česká Akademie Věd a Umění). Bulletin International Résumés des travaux présentés Classe des sciences mathématiques naturelles et de la médecine Année 28 (1927) Pp vi+450 (Prague)

United States Department of Agriculture Technical Bulletin No 178 Properties of Soils which influence Soil Erosion By H E Middleton Pp 16 (Washington D C Government Printing Office) 5 cents

American Geographical Society Special Publication No 11 Brief History of Polar Exploration since the Introduction of Flying By W L G Joerg To accompany a Physical Map of the Arctic and a Bathymetric Map of the Antarctic Pp v+50+2 maps (New York) 3 dollars

The Carnegie Foundation for the Advancement of Teaching Bulletin No 25 The Social Philosophy of Pensions with a Review of existing Pension Systems for Professional Groups By Henry S Pritchett Pp iv+85 (New York City) Free

Collection des travaux chimiques de Tchécoslovaquie Rédigée et publiée par E Votoček et J Heyrovský Année 2, No 4 Avril Pp 161 208 (Prague Regia Societas Scientiarum Bohemica)

Naturwissenschaftliche Untersuchungen des Sarekgebirges in Schwedisch Lappland Band 2 Meteorologie und Geophysik Lief 2 Untersuchungen über die Wolkenbildung auf dem Partetjåkko im August 1928 nebst einer erweiterten Untersuchung der Tropfengruppen Von Hilding Köhler Pp 77 128 (Stockholm C E Fritze, Berlin R Friedländer und Sohn)

Journal of the Faculty of Agriculture Hokkaido Imperial University, Sapporo Japan Vol 28 Part 1 Ein Beitrag zur Kenntnis der Gattung *Rhizopus* I Von Yoshihiko Yamamoto Pp 101+4 Tafeln (Tokyo Maruzen Co Ltd)

Division of Fish and Game of California Fish Bulletin No 20 The Commercial Fish Catch of California for the Year 1928 By the Staff of the Bureau of Commercial Fisheries Pp 110. (Sacramento California State Printing Office)

United States Department of the Interior Office of Education Bulletin 1929, No 31 Legal Education 1925-1928 By Alfred Z Reed Pp 2? (Washington D C Government Printing Office) 5 cents

Proceedings of the California Academy of Science Fourth Series Vol 18 No 17 and No 18 Report of the President of the Academy for the Year 1929 by C E Grunsky Report of the Director of the Museum and of the Aquarium for the Year 1929 by Barton Warren Evermann Pp 531 586 (San Francisco)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol 82 Genotypes of the Scrophulariaceae in the first edition of Linné's Species Plantarum By Francis W Pennell Pp 9-26 The Fresh water Fishes obtained by the Gray African Expedition 1929 with Notes on other Species in the Academy Collection By Henry W Fowler Pp 27 83 The East African Forms of the Bare Throated Francolin *Pternistes cranchii* By W Wedgwood Bowen Pp 85-87 (Philadelphia)

Smithsonian Miscellaneous Collections Vol 82 No 6 The Past Climate of the North Polar Region By Edward W Berry (Publication 3061) Pp 29 (Washington D C Smithsonian Institution)

CATALOGUE

The Nickel Bulletin Vol 3 No 4 April Pp 105 136 (London The Mond Nickel Co Ltd)

Diary of Societies

FRIDAY, MAY 2

ROYAL SOCIETY OF MEDICINE (Otology Section) (Annual General Meeting) at 10 30 A M —Papers by Prof M Sourdille and G J Jenkins

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion) at 4 30 —The Earth s Bodily Tide Dr J Proudman Dr H Jeffreys and J C Dobbie Chairman, Prof L N G Filon

ROYAL SOCIETY OF MEDICINE (Laryngology Section) at 5 —Annual General Meeting

ROYAL SANITARY INSTITUTE (at Town Hall, Tunbridge Wells), at 5 30 —Dr F C Linton and others Discussion on The Maternity Home as a Health Asset —H T Taylor and others Discussion on Can the Slum be Abolished?

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7 —C W Marshall The Metering Arrangements for the Grid Transmission System in Great Britain (Lecture).

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7 —Major A W Farrer Empire Free Trade and the Engineer

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group) at 7 —Informal Meeting

GEOLOGISTS ASSOCIATION (at University College), at 7 30 —A A Millar and J S Turner The Lower Carboniferous Succession along the Dent Fault and the Yoredale Beds of the Shap District —R G S Hudson The Carboniferous of the Craven Reef Belt The Namurian Unconformity at Scaleber, Nr Settle

FARADAY SOCIETY (at Chemical Society), at 8 —Prof G Wiegner On Coagulation (Lecture).

PHILOLOGICAL SOCIETY (at University College), at 8 — Anniversary Meeting

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section) (Annual General Meeting), at 8 30 —Dr R J Clausen Ethylene Anæsthesia.

ROYAL INSTITUTION OF GREAT BRITAIN at 9 — H E Wimperis A Study of the Phenomenon of Spin in Airplanes

MONDAY, MAY 5

ROYAL SOCIETY, EDINBURGH at 4 30 —Dr R Crookall On Some Curious Fossils from the Downtonian and Lower Old Red Sandstone of Scotland —A. C Stephen Studies on the Scottish Marine Fauna. Additional Observations on the Fauna of the Sandy and Muddy Areas of the Tidal Zone —Dr E A T Nicol The Feeding Mechanism Formation of the Tube, and Physiology of Digestion in *Sabella pavonina* Dr R A Fisher The Distribution of Gene Ratios for Rare Mutations —F S Allan The General Form of the Orthogonal Polynomials for Simple Series with Proofs of their Simple Properties

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 —General Monthly Meeting

ROYAL COLLEGE OF SURGEONS OF ENGLAND at 5 —Sir Arthur Keith The Anatomy of Fossil Man *Homo Cardarensis* discovered in Greenland and recently described by Prof Fr C C Hansen of Copenhagen

SOCIETY OF ENGINEERS (at Geological Society), at 6 —H R. Lintern The Methods of Testing the Lubricating Values of Oils Greases etc

BRITISH PSYCHOLOGICAL SOCIETY (Joint Meeting of the Æsthetic and Education Sections) (at Bedford College), at 6 —W Platt The Child's Innate Sense of Music

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society) at 8 —Prof G T Morgan Observations on the Condensations between Formaldehyde and Aromatic Compounds

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8 30 —Major R W G Hingston The Oxford Expedition to British Guiana

TUESDAY, MAY 6

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 5 30 —Annual General Meeting

ZOOLOGICAL SOCIETY OF LONDON, at 5 30 —Dr S M Manton Notes on the Habits and Feeding Mechanisms of *Anaspides* and *Paranaspides* (Crustacea Syncarida). —Col A E Hamerton Remarks on Trypanosomiasis in Relation to Man and Beast in Africa

INSTITUTION OF CIVIL ENGINEERS, at 6 —Prof R V Southwell Aeronautical Progress, 1914-1930 (James Forrest Lecture)

IRON AND STEEL INSTITUTE (at Chamber of Commerce Birmingham) at 7 —J A. Jones Chromium Copper Structural Steels —M L Becker Carburising and Graphitising Reactions between Iron Carbon Alloys Carbon Monoxide and Carbon Dioxide —A L Norbury and E Morgan The Effect of Melting Conditions of the Microstructure and Mechanical Strength of Grey Cast Irons containing Various Amounts of Carbon and Silicon - R Whitfield Single Sheet or Thin Pack Normalising or Heat Treatment *versus* Box Annealing of Sheets.

ILLUMINATING ENGINEERING SOCIETY (at Royal Society of Arts), at 7 — T Austin Luminous Traffic Signals.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN at 7 —J A Hall Some Problems of the Printing Process

TELEVISION SOCIETY (at University College), at 8 —R Neville-Gray Liquid Photo electric Cells (Lecture)

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8 30 — Major Trevor Great Zimbabwe

WEDNESDAY, MAY 7

ROYAL SOCIETY OF MEDICINE (History of Medicine Section) at 5 — Annual General Meeting

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Sir Arthur Keith The Anatomy of Fossil Man The Mammoth Hunters of Moravia and their Relationship to other Ancient Races of Europe

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section) at 6 —P P Eckersley and N Ashbridge A Wireless Broadcasting Transmitting Station for Dual Programme Service

SOCIETY OF GLASS TECHNOLOGY (London Section) (at Holophane Ltd Elverton Street S W) at 7 30 —Discussion on The Measurement of Temperature in Furnaces

INSTITUTE OF METALS (at Institution of Mechanical Engineers) at 8 — Major F A Freeth The Influence of Technique on Research (May Lecture)

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8 —Dr L H Lampitt, E B Hughes and H S Rooke The Diastatic Activity of Honey —Dr W R Schoeller A New Method for the Separation of Titanium from Zirconium and Hafnium —E R Bolton and K A Williams The Composition and Polymerisation of Chinese Wood (Tung) Oil

ROYAL SOCIETY OF ARTS, at 8 —S K Ratcliffe National Parks

THURSDAY, MAY 8

CHEMICAL SOCIETY (at Salters Hall St. Swithin's Lane, E C 4), at 5 30 — Prof Niels Bohr Chemistry and the Quantum Theory (Faraday Lecture)

CHILD STUDY SOCIETY (Annual Meeting) (at Royal Sanitary Institute), at 6 —T J Faithfull The Re Education of the Difficult Child

BRITISH INSTITUTE OF RADIOLOGY (in Reid Knox Memorial Hall), at 6 — Prof J Murdoch The Problem of Dosage in Radium Therapy (Lecture).

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN at 7 —L D Talamon The Hypersensitisation of Colour Plates

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7 30 —F Twyman and Dr F Simeon The Wedge Sector for Quantitative Spectrum Analysis. —E T Hanson On the Diffraction of Light by a Slit —Demonstration by E F Fincham of a New Ophthalmoscope.

FRIDAY, MAY 9

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4 30 —Dr D Clouston The Report of the Royal Commission on Agriculture

ROYAL ASTRONOMICAL SOCIETY at 5 —Dr J S. Plaskett The High Temperature Stars (George Darwin Lecture). — Radcliffe Observatory, Oxford Positions of the New Planet from Photographs taken at the Radcliffe Observatory

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Sir Arthur Keith The Anatomy of Fossil Man The Races represented by Fossil Remains discovered by Miss Dorothy Garrod in the Caves of Palestine

PHYSICAL SOCIETY (at Imperial College of Science), at 5 —E J Williams (*a*) The Inductance of Electromotive Forces in a Moving Liquid by a Magnetic Field, and their Application to the Investigation of the Flow of Liquids (*b*) The Motion of a Liquid in an Enclosed Space —E. Simeon The Generation of Sound by the Siren Principle —Demonstration by Dr A G Milligan of the Regional Absorption of Dyes by Crystals of Alum and Rochelle Salt

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5 30 —Annual General Meeting

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society) at 6

INSTITUTION OF ELECTRICAL ENGINEERS (London Students Section) (Annual General Meeting) at 6 15 —J W Moffatt and J C Emerson The Rotary Automatic Telephone System

BEDSON CLUB (Armstrong College Newcastle upon Tyne), at 6 30 —Prof J B Cohen Synthetic Drugs (Bedson Lecture)

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (Annual General Meeting) (at Criterion Restaurant Piccadilly) at 6 45 — Sir Frederic L Nathan and others Discussion on The International Abstracting and Classifying of Scientific Literature —Dr H Levinstein Chemistry House—the Present Position —H J Pooley The Jubilee Meeting of the Society

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 — Prof J Garstang, Archæology and Bible History

ROYAL SOCIETY OF MEDICINE, at 9 —Prof J Murdoch Radium Treatment of Cancer (Lecture).

SATURDAY MAY 10

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section) (at Torquay)

PHYSIOLOGICAL SOCIETY (in Physiology Department, Cambridge).

SUNDAY, MAY 11

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section) (at Torquay)

PUBLIC LECTURES

MONDAY, MAY 5

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY at 5 30 —Prof Graham Wallas Physical and Social Science (Huxley Lecture)

UNIVERSITY COLLEGE at 5 30 —Prof J Macmurray The Conception of a Personal Universe the Problem of Modern Philosophy

TUESDAY, MAY 6

GRESHAM COLLEGE, at 6 —A R Hinks The New Planet beyond Neptune (Succeeding Lectures on May 7, 8 and 9)

WEDNESDAY, MAY 7

KING'S COLLEGE, at 5 —Prof J A Gunn Pharmacological Reactions of Involuntary Muscle (Succeeding Lectures on May 8 and 9)

UNIVERSITY COLLEGE at 5 30 —Prof F J Cole The Early History of Generation and Comparative Anatomy (Succeeding Lectures on May 8, 14, 15 21 and 22)

THURSDAY, MAY 8.

INSTITUTE OF PATHOLOGY AND RESEARCH ST MARY'S HOSPITAL PADDINGTON, at 5 —Dr W E Gye The Action of Antiseptics on the Virus of Filtrable Tumours

BIRKBECK COLLEGE at 8 —Prof J Graham Kerr A Biologist on the Training of the Citizen

FRIDAY, MAY 9

BIRKBECK COLLEGE at 8 —Prof J Graham Kerr Primitive Fish and the Light they cast upon the Structure of Vertebrates

ANNUAL MEETING

MAY 1 AND 2

IRON AND STEEL INSTITUTE (at Institution of Civil Engineers)

Friday May 2, at 10 A M —Announcement of Award of the Andrew Carnegie Research Scholarships for 1930-31 Announcement of Award of the Williams Prize to W E Simons

Dr W Rosenhain and C H M Jenkins Some Alloys for Use at High Temperatures Nickel-Chromium and Complex Iron-Nickel Chromium Alloys Part I —C H M Jenkins, H J Tapsell, C R Austin, and W P Rees Part II

J L Haughton and M L. Becker Alloys of Iron Research Part IX The Constitution of the Alloys of Iron with Silicon

M L Becker Carburising and Graphitising Reactions between Iron Carbon Alloys Carbon Monoxide, and Carbon Dioxide

A L Norbury and E Morgan The Effect of Melting Conditions on the Microstructure and Mechanical Strength of Grey Cast Irons containing Various Amounts of Carbon and Silicon

A R Page and J H Partridge The Properties of some Steels containing Chromium

D Brownlie The History of the Cementation Process of Steel Manufacture Part I —Baron de Laveleye Part II

S. Maita The Corner Ghost in Steel Ingots

CONGRESS.

MAY 19, 20, AND 21

INTERNATIONAL CONGRESS ON MALARIA (at Algiers)

SATURDAY, MAY 10, 1930

CONTENTS.

Editorial and Publishing Offices
MACMILLAN & CO., LTD.,
ST MARTIN'S STREET, LONDON W C 2

The Yield of Coal Seams

AN important paper on the yield of coal seams was read by Messrs Bocking and Bailey before the South Staffordshire and Warwickshire Institute of Mining Engineers in February last, and a separate copy has just reached us The main object of the paper appears to be to point out that the generally adopted basis of calculation of the yield of coal seams, namely, 1200 tons per foot thickness per acre (or, as it is often put, 100 tons per inch thickness per acre), is too low and that it would be safe to substitute a higher figure The authors explain that by the thickness of a coal seam they mean not the true thickness as measured between roof and floor at right angles to the seam itself, but the vertical thickness of the coal seam This method of calculation is of course quite sound and has the advantage that the dip of the coal seam need not enter into the calculation The generally accepted figure is one that has been used for a very long time, among the interesting manuscripts in the library of the North of England Institute of Mining and Mechanical Engineers, one of the most interesting is the journal of John Watson, a local mining engineer of considerable reputation and eminence in the latter part of the eighteenth century This journal contains the following entry under date of July 19, 1746

"An Acre of Coal or the Coal that lies under An Acre of Land in a Six foot Seam will Produce 143 Tens of Coal at 22 Waggons to a Ten and 19 Bolls to a Waggon and 36 Gallons to a Boll according to the best computation"

Apparently a 'ten' of coal varied somewhat in weight, but was about 50 tons, so that the above quoted figures come out at about 1200 tons per foot per acre, and apparently mining engineers have been content to use this ancient figure without inquiring too closely whether it applies to present-day conditions or not There is, however, an important point which has not been brought out either in the above paper or the interesting discussion that followed it, namely, as to what precisely is meant by the yield per acre The authors and all the speakers who took part in the discussion appear to have taken this phrase to mean the amount of coal got from an acre actually worked out The other sense, in which the above phrase is more generally employed, is as a basis for the calculation of the amount of coal that may be expected from an estate of a given acreage, underlain by coal seams of a given total vertical thickness, before mining operations have commenced on

the estate in question In other words, the estimate of 100 tons per inch per acre refers to the amount of coal that can be expected to be produced by an estate of given size, making due allowance for all possible faults, dykes, and 'wants' of any kind due to geological conditions as well as for the coal necessarily left behind in pillars, barriers, etc It must also be remembered that this estimate apparently originated in the Great Northern Coal field where bord and pillar working is customary and where it is not unusual for 'stooks' of coal to be left behind surrounded by goaf, which are usually too badly crushed to be worth getting Furthermore, this calculation also makes allowance for the shaft pillars, that is, for the coal left to support the shafts and the buildings and machinery round about the shafts, theoretically, all the coal in these pillars should be won before the colliery is finally abandoned, but it often happens that a good deal of it is too badly crushed to be worth winning when the time for getting it ultimately arrives

Messrs Bocking and Bailey point out quite correctly that the real amount of coal contained in a coal seam is of the order of 1500 to 1600 tons per foot per acre, and quote examples to show that such amounts have repeatedly been won by the getting of a definite area of coal Obviously, this statement, which is undoubtedly perfectly true and is amply proved by the evidence which the authors bring forward, is not necessarily in contradiction with the above named preliminary estimate, as the latter would only mean that the mining engineer in making his calculation makes an allowance of 20 25 per cent of the total coal that might be present, which he expects either to lose in the course of mining operations or not to find at all owing to the natural causes above indicated Probably the authors are right in suggesting that such an estimate errs on the side of caution, but most mining engineers will plead that it is well to be on the safe side in drawing up preliminary estimates when there are so many unknown factors, the majority of which will tend to diminish rather than to increase the quantity of coal that a given area will actually yield It may, however, be fairly conceded that the suggestion that under present day practice, where the geological features of the coalfields are so much better known than they were, and where modern methods of working restrict far more severely the waste of coal that used to obtain in the past, the percentage allowed is too high and that it might be reduced with advantage

As to the view that mining engineers working a coal seam should do their utmost to get the maximum possible yield from that seam, no mining engineer will dissent from it, and in fact this may be said to be the invariable practice to day, only qualified by the consideration that the working of a colliery is an economic proposition, and that as soon as the extraction of the last portions of a coal seam cost more than the coal thus saved is worth, it is sound practice not to attempt to save it, but to stop the operations at the most economic point It may be urged that such a practice represents a definite loss of national resources, and this is undoubtedly true except from the point of view that coal which costs more to market than it will fetch in the market is a national liability and not a national asset

A Text-book of Medical Entomology

Insects, Ticks, Mites, and Venomous Animals of Medical and Veterinary Importance Part 1 *Medical* By Prof Walter Scott Patton and Dr Alwen M Evans Pp x + 785 + 61 plates (Liverpool Department of Entomology, Liverpool School of Tropical Medicine, 1929) 20s

SOME realisation of the importance which entomology has assumed in the service of modern medicine will be obtained by scanning the pages of this up to date book, the joint authors of which have each in their respective fields gained considerable reputations as medical entomologists This is the first of four volumes which, when all have been published, will cover the field of entomology in its bearing upon human medicine, public health, tropical hygiene, and veterinary medicine It has been prepared to meet the needs of medical graduates qualifying for the diploma in tropical medicine at Liverpool

A striking feature is the departure from the idea of a conventional scientific text book, for the usual chapter subdivisions there has been substituted an arrangement of the subject into twenty eight lecture meetings, each of which occupies approximately one hour and is followed by one hour's instruction in the laboratory, where the student examines a series of prepared demonstration specimens illustrating the lecture The book is really an exposition of a method of teaching which, unfortunately, has entirely missed the viewpoint of the non Liverpool student, and it will not be an easy matter for the latter to interpret the sketchy, synoptic lecture notes, that require amplification in the actual lecture The following example taken

from the synopsis of lecture 6 on p 276 dealing with the *Aëdes* group of mosquitoes will serve to illustrate the difficulties the average reader encounters

"Important species —*Stegomyia fasciata* (*calopus*, *argenteus*, *ægypti*) Distinguishing characters Bionomics Domesticity Feeding habits Breeding places, typical and atypical Importance of resistance of egg to desiccation Duration of early stages Length of life of ♀ Distribution, *see* map I Relation to Disease, *see* notes on Lecture 4 *S albopicta* (*scutellaris*) Distinguishing characters Bionomics Breeding places Distribution, *see* notes on specimen 200 Relation to Disease, *see* notes on Lecture 20"

Specimen 200 referred to in the quotation is one of 558, which are examined by the student in the course of his laboratory practice of twenty eight hours This works out at three minutes per specimen, which seems barely sufficient for the beginning student faced with a mass of new detail and an unfamiliar terminology As the book has been largely written around these demonstration specimens, the result has been to restrict its usefulness to the Liverpool student

An analysis of the contents shows that the initial 180 pages are devoted to minute structural anatomy Here the authors have made extensive use of the technique of double embedding in celloidin and paraffin for the sectioning of densely chitinised structures such as insect mouth parts, which are not readily cut by the single embedding method They have thus been able to demonstrate clearly the exact relations to each other of the intricate piercing parts of many of the smaller blood sucking species Strict attention to morphological detail is, indeed, the keynote of the whole work, and the representation of the mouth parts of a female *Ceratophyllus fasciatus* in Fig 275, p 514, reflects the accuracy of the authors' methods in preparing minute objects for microscopic study On the other hand, the reader will find that the physiological aspects of entomology have been overlooked, and that little consideration is given to the insect as a living organism capable of responding to changes in its ecological conditions This neglect of physiology is regrettable when one remembers that the whole superstructure of the control of insect pests rests on our knowledge of their habits and behaviour Nevertheless, it must not be forgotten that it is only by careful anatomical studies that the presence of the larvæ of heteroxenous helminthes in insects can be revealed Thus a reawakening of interest in the study of internal insect anatomy might lead indirectly to a much desired extension of our knowledge of this important group of helminthes Incidentally, there is here an opportunity for valuable co operation between the entomologist and helminthologist, which up to the present has been largely neglected

The remainder of the book is devoted to the blood sucking Nematocera (180 pages), for which the junior author is mainly responsible, Brachycera (104 pages), Cyclorrhapha (178 pages), Siphonaptera (47 pages), Anopleura (60 pages), Acarina (89 pages), and venomous animals (16 pages) The penultimate lecture deals with the dissection of the mosquito and with routine methods of collecting, preserving, and mounting insects (29 pages) General principles of insect control and the specific control of mosquitoes and tsetse flies form the substance of the final lecture (35 pages)

Whatever criticism may be advanced against the book in other directions, very little exception will be taken to the profuse illustrations, which have achieved a high standard of excellence Anything finer than the wash drawings of Mrs Patton and Mr Terzi could not be readily imagined, whilst the line drawings of the junior author, Dr Evans, are notable because of their meticulously careful workmanship The photographic reproductions contributed by Miss Brown could scarcely be surpassed, and Plate XXIII, representing the mature larva of *Gasterophilus intestinalis*, is a typical example of the wealth of detail that her technique can produce In the circumstances, it is unfortunate that the arrangement of the plates in reference to the text should appear to be haphazard Plate XXIII, for example, is to be found facing p 278 in the section of the book which deals with mosquitoes, whilst the Gasterophilinæ are discussed on pp 327, 336 341, and 466 467 Further, it is curious to find that no description of the mature larva of *G intestinalis* has been furnished, and no reference to the plate is made in the text Despite the space, too, devoted to the sub family, the reader is advised in the summary of Lecture 8, p 341, that "medical officers are not expected to recognise any stage of the Gasterophilinæ"

Attention must be directed to one or two liberties that have been taken with the classification of the Diptera It is generally recognised that changes have to be made in existing schemes of classification when advancing knowledge has revealed new facts of phylogeny All such changes must, of course, be supported by sound reasons Bearing this in mind, the summary elimination by the authors of the section Aschiza of the Cyclorrhapha cannot be

defended merely on the pretext that it is difficult for the teacher to demonstrate the presence or absence of the ptilinal suture "with a pocket lens magnifying 10 diameters" The question then arises as to the position of the Syrphidæ, a family which is of minor medical importance, because of the occasional recorded occurrence of the rat tailed maggot in the human intestine This difficulty has been evaded by the degradation of the family to the rank of a sub family Syrphinæ, which is then included with others in the family Muscidæ Calypteratæ Again, the family Œstridæ has been relegated to the scrap heap and replaced by four new sub families, Gasterophilinæ, Œstrinæ, Hypodermatinæ, and Cutiterebrinæ, which are added to the Muscidæ Calypteratæ We are not enlightened as to the authors' reasons for this treatment of the Œstridæ, good as they may be Finally, the sub order Pupipara has been rejected and its component genera elevated to sub families In the illustrated synoptic table at the end of the book we find one of them, the Hippoboscinæ, included under the Muscidæ Calypteratæ, which has become a rather unwieldy assemblage It would almost seem as if the authors had fallen into the trap, which they thought to avoid The making of artificial changes in a natural group is the negation of scientific method, and where taxonomy is concerned a judicious use of the axe is recommended On the basis of our present knowledge, the Pupipara should be maintained as a separate sub order Although its association with the Glossininæ in the Muscidæ may appear to be justifiable on the grounds of similarity of mode of reproduction, the two are sufficiently divergent structurally to warrant their maintenance as separate entities

It is regrettable that a scientific text book intended for the use of post graduate medical students should contain several mis statements of fact Among others, we note on p 109 that the ovarian tubules are wrongly designated ovarian follicles The larvæ of *Wuchereria bancrofti* (p 199), *Loa loa* (p 296), *Habronema muscæ*, and *H megastoma* in their respective, intermediate, insect hosts are erroneously referred to as embryos *Ctenocephalus* (p 527) is said to have "eight, rarely seven, genal combs", whereas species of this genus have but a single genal comb composed of seven or eight spines Typographical errors are fairly numerous both in the text and in the index In the latter, we note on referring to leeches that the reader is recommended to see Hirudinea, only to find that no mention is made of the Hirudinea in the index!

It has been the worthy ambition of the authors to furnish a reasonably priced book, which would serve the needs of both the beginner and the medical graduate doing research work in the tropics The beginner, on one hand, is swamped by the mass of detail, whilst the research worker will find the omission of a bibliography a serious defect By the exercise of a stricter discrimination in the choice of material, the authors could have condensed the book considerably, and thereby enhanced its value The lack of a definite plan of arrangement makes it difficult for the beginner to get readily a concise, connected account of the various stages and life history of any particular, medically important species In place of this single volume combining the systematic and practical parts of the subject, the authors would have made a wider appeal by publishing a more conventional text book and, separately, a practical laboratory guide

Statistical Mechanics without Tears

Introduction to Statistical Mechanics for Students of Physics and Physical Chemistry By Prof James Rice Pp x+333 (London Constable and Co, Ltd, 1930) 18s net

ABSTRACT dynamical theory, classical or quantum mechanical, deals always in the first instance with comparatively simple systems such as planetary systems or atoms, finding even there complications sufficient to require our utmost skill to unravel Chemists and physical chemists always, physicists more often than not, and sometimes even astronomers, study large aggregates of such 'simple' systems and are then interested only in the properties which they exhibit in the mass It is the province of statistical mechanics to derive from the properties of individual 'molecular' systems the observable properties of these large aggregates As such, statistical mechanics is a key subject, of which the principles at least should be familiar to all students of these branches of science It is therefore all the more distressing that there has never before been available, at least in English, a really good, clear, really elementary book on statistical mechanics The difficulty of writing such a book for the proper audience is of course obvious

The subject requires inevitably considerable mathematics, and is apt to develop the more happily the more mathematics is allowed The problem, then, is to write a book which shall give a real account of statistical mechanics without shirking, but with the minimum of mathematics, and with

every *mathematical* process of more than ordinary difficulty carefully led up to by the discussion of simple examples For such a book we have had long to wait, but our long wait has been amply rewarded by Prof Rice, whose book now under review must be recorded both in form and execution to be as nearly as possible all that such a book should be

A student of physics or chemistry, who has mastered this book but gone no further, should at the least have gained a clear idea of the fundamental connexion between his more usual subject matter and the theories and facts of atomic physics, and of the methods by which this connexion must be further explored The majority of serious students ought to be able to master it, for it is admirably free from complications of merely mathematical technique A student who can master it with ease will find it an admirable introduction to more advanced works on statistical mechanics and (generally) the properties of matter in bulk, in which a more educated mathematical outlook is assumed in the reader The book should be widely read and pass rapidly to a second edition

In these circumstances, it seems worth while to mention certain minor features which perhaps might be altered, or at least reconsidered, with a view to improving the second edition

In the first place, it seems a pity to preserve in Chapter ix, presumably for historical reasons, the erroneous account of van der Waals's equation in which the effect of the 'clustering' of the molecules is ignored, that is, the effect of the Boltzmann distribution factor The account given is, of course, van der Waals's own account, but since it involves an incorrect working out of his own initial hypotheses about the constituent molecules, and since the correct working out is only slightly more complicated, might not the old form now be dropped? The author gives an excellent accurate account of his own in the later part of the chapter

Secondly, is it not time to jettison also once for all Planck's second quantum theory? It never was much of a theory, always plagued with an internal irreversibility which was really utterly destructive from the first, though of course not at first so appreciated Planck himself, though he would not readily abandon it, finally admitted himself beaten by the Stern-Gerlach experiment

Thirdly, some typographical trivialities It would be pleasant to have the possessive of van der Waals correctly printed, and in numbers of places *o* is wrongly printed for 0 Is there not also some confusion between the work function and the true free energy?

Fourthly, it might perhaps be argued that the specific heats of gases are rather inadequately discussed One would have liked more details about hydrogen, for example, Why not, in fact, an account of the complete and successful theory of Dennison? And why not a fairly complete account of some other gas at higher temperatures? It is a pity not to discuss the specific heat of the rigid rotator as given by what is now known to be the correct quantum mechanical formula, but to waste time discussing a partition function now of little theoretical interest

This leads one naturally on to a final more general point The weak point of the book seems to be an absence of detailed numerical comparisons between theory and experiment Specific heats and chemical constants are the natural places for such comparisons, but comparisons except in general statements are almost entirely lacking To include some such comparisons would make the book longer, for there is little if any space to be saved, to prepare them is a most unpleasant task, as the reviewer knows to his cost, but they would be very well worth while

These are small points, utterly negligible compared with the general excellence of the book, on which the author is to be most heartily congratulated R H F

Outlook of Higher Education

Education at the Crossroads By Lord Eustace Percy Pp iv + 104 (London Evans Bros, Ltd, n d) 5*s* net

LORD EUSTACE PERCY'S appointment as Minister of Education in the last government no doubt seemed to most people to have no particular significance The new Minister, however, soon evinced unusual signs of wanting to see things for himself and of both forming opinions of his own and expressing them This he did in an arresting manner, and with such an unusual avoidance of the customary rotund qualifying phrases of a cabinet-haunted Minister that there was on the part of some much fear, and on the part of others a good deal of hope, that he might end in some first-class indiscretion Now Lord Eustace has written a book, yet his adversaries (if he still has any) can scarcely rejoice, for if it is coloured by any political cast of thought, the candour, the large mindedness, and the courage exhibited in the book must surely disarm them

In about a hundred pages of clear print and in excellent English, Lord Eustace gives us a comprehensive survey of the region of education on which the greatest questions in our national system wait for solution There are six chapters dealing respectively with the universities and technical colleges, the universities and the schools—recent tendencies, the universities and the schools—a plea for a university policy, technical education, the idea of a local college, and universities and local colleges as partners In these chapters the difficulties of the present situation are set forth with extraordinary clarity and the measures are indicated which, according to the author's belief, would afford a practicable solution of these difficulties

The book is so terse (the author modestly terms it an essay), so closely packed with matters of interest, that it is difficult to proceed with a further indication of its contents and character without wholesale quotation It is perhaps most noteworthy, and also most praiseworthy, in exhibiting the author's full sense of the responsibilities of universities, both old and new, in relation to our whole educational system and national needs While frankly calling them to account, he shows a complete understanding of their rights and privileges, and he has conceived no idea of imperilling their souls by any measures of regimentation Lord Eustace addresses himself, evidently with equal first-hand knowledge, to the complex questions surrounding technical colleges, and here again he writes alike with firmness and sympathy of their failings and their future Particularly noticeable in this connexion is his proposal to bring adult education of the Workers' Educational Association type into organic relation with the institutions now called technical, and so to create a distinct all round local college

Incidentally, the author has emphatic comments to make on undue specialisation in school years and on narrowness in all regions of education He shows a real appreciation of the position of science in our national life—and more sympathy than perhaps would be expected with efforts to make science what men of that calling think it should be

In concluding this notice the reviewer would like to say that his recommendation of the book is based on the conviction that at the present day there is, and for some time to come there will be, a strong call on men of science, especially those with university responsibility, to give more time to the subject of our national education in its widest aspects Everyone admits that the times are critical, everyone says that education is of fundamental consequence, but few make any really serious study of it Uninformed educational talk is one of the more wearying of afflictions, and the *obiter dicta* of emphatic people who say this, that, or the other is the one remedy for all educational ills, are very distressing It is not said here that Lord Eustace Percy has given us a gospel, but he has with a merciful economy of words stated a most important case

At the outset he says "it is a safe rule that an ex-minister should in general refrain from writing books about the department for which he has been responsible" Whilst violating the letter he hopes that he does not violate the spirit Of this readers will, we are sure, fully acquit him, and be grateful for a temperate discussion of great questions by one who has had and may continue to have a chief responsibility in settling them

Arthur Smithells

Our Bookshelf

Dr H G Bronns Klassen und Ordnungen des Tierreichs wissenschaftlich dargestellt in Wort und Bild Band 5, Abteilung 4, Buch 3 *Tardigrada* Bearbeitet von Ernst Marcus Pp viii + 608 (Leipzig Akademische Verlagsgesellschaft m b H, 1929) 84 gold marks

This monograph is divisible into two almost equal parts, the first on structure, physiology, and ecology, and the second on systematics A brief statement of the distinguishing characters of the Tardigrada prefaces the first part The small size of these animals is sufficiently evident from the fact that in only two of the nineteen genera does the length reach 1 2 mm, and the majority of the genera contain forms less than half this length The author gives in 90 pages careful systematic descriptions, aided by excellent figures, of the external features and internal anatomy, and then proceeds in the next 30 pages to an account of the egg-laying habits and of the development based chiefly on that of the genus *Hypsibius*

The chapter on the physiology includes many interesting details of the powers which Tardigrades possess of withstanding drying and even repeated drying According to recent investigations, the Macrobiotes can remain viable in the so called barrel form, in dry air at 15° C, for six and a half years, but after eight years in this dry state they cannot be revived In the examples which had been dry for six and a half years movement was first observed about four hours after moisture had been supplied The account of encystation is also thoroughly adequate The section on ecology refers among other matters to the adaptations met with in shore-dwelling species and in those living among mosses A useful account is given of methods of collecting and examining Tardigrades, and is followed by a

short history of our knowledge of the group from the first observation of 'small water bears' by J A E Goeze in 1773

The systematic part contains clear descriptions of nineteen genera and subgenera, and of 274 species, 107 of which are regarded as doubtful The bibliography contains a list of 188 publications, and there is an excellent index The author, who is a keen investigator of the Tardigrada, has expended much thought and care on the preparation of this monograph, which maintains the high standard of the great series of which it forms a worthy part

The Immunology of Parasitic Infections By Prof William H Taliaferro (The Century Biological Series) Pp xv + 414 (New York and London The Century Co , 1929) 6 dollars

THIS book, which is dedicated to Theobald Smith, a pioneer in many fields of biological inquiry, is the first of its kind to present to the reader a collation and analysis of practically all the papers of any importance which have been written on the subject of immunity processes in protozoal, helminthic, and other non-bacterial infections Immunological inquiry in this field has been by no means barren in practical and theoretical results The demonstration of specific antibodies in the sera of persons suffering from helminth infection, hydatid disease, and schistosomiasis particularly, has greatly assisted diagnosis So also have the many allergic skin reactions capable of being elicited when extracts of protozoa, helminths, etc , are introduced into the dermis

Such applications of immunology to practical diagnosis are, however, excelled in interest by the light which these studies are likely to throw on problems of normal resistance and susceptibility to parasitic infections The antigenic constitution of the protozoal or helminthic unit is now receiving the attention it deserves, and specialists in this field will be grateful to Prof Taliaferro for his admirable survey of the relevant literature As well over a thousand papers are cited with their full titles, the work forms a most valuable book of reference J C G L

Jahrbuch des Forschungs-Instituts der Allgemeinen Elektricitats Gesellschaft Band 1 1928–1929 Pp 240 (Berlin Julius Springer, 1930)

THIS volume is the first issued by the Research Institution of the Allgemeine Elektricitats Gesellschaft It contains a wonderful record of research work in both applied and pure science of the highest class Brief historical introductions are given to the various subjects The book opens with a section on acoustics The A E G method of connecting up tone (talkie) films is first described and then the experimental groundwork on which it is based is given The line diagrams are very clear and the photographs of the apparatus are instructive The advanced mathematics of the vibrations of membranes are given and very striking examples of nodal figures are drawn

The section on electrotechnics is very brief Photographs are given of the A E G relays suitable for long-distance communication The sections on atom and electron physics record a great deal of valuable research Corpuscular waves and their application for analysing crystal structures are well described Instructive data are given about the contact potential between two similar metals Under electro-optics two useful papers on the polarisation of canal rays are given The volume finishes up with an article by C Ramsauer pointing out the importance of technical research laboratories and emphasising the connexion between prosperity and research

Annals of the Pickett-Thomson Research Laboratory Vol 5 *The Pathogenic Streptococci, their Rôle in Human and Animal Disease (continued)* Pp xi + 392 + 46 plates (London Baillière, Tindall and Cox , Baltimore, Md Williams and Wilkins Co , 1929) 42*s* net

VOL 5 of the Annals of the Pickett Thomson Research Laboratory continues the photographic register of streptococcal growths from oral, dental, tonsillar, and puerperal sources It contains 46 plates of excellent photographs and a letterpress of nearly 400 pages devoted to lengthy excerpts from a curiously unselected mass of literature on streptococci and their many activities The work fully merits the authors' own estimate of 'gigantic', but it is not science To the authors a streptococcus is known by the appearance of its colony on a particular medium, and on this basis there is little room left for variation It is difficult to see why it should be thought worth while to spend money on the production of these expensive volumes It is of some interest, perhaps, that the first two plates illustrate the alteration in the flora of the gums following the use of a proprietary tooth paste containing a streptococcal vaccine prepared by the authors

The Kinetics of Chemical Change in Gaseous Systems By C N Hinshelwood Second edition Pp vi + 266 (Oxford Clarendon Press , London Oxford University Press, 1929) 12*s* 6*d* net

IN order that the progress made in the past three years in the study of the kinetics of chemical change in gaseous systems may be adequately recorded, Mr Hinshelwood has prepared a second edition of his book For this purpose the chapters on energy of activation and on unimolecular reactions have been completely rewritten and a chapter on chain reactions has been added This new chapter contains the interesting suggestion that 'intensive drying' is efficient only in a limited range of chemical actions, which proceed either instantaneously or not at all, and that the trace of water, which makes it possible to propagate these actions, provides centres from which branching chains proceed A sharp distinction is drawn between changes of this type and reactions which proceed with stable and measurable velocities, and it is contended that observations made with one group of changes cannot logically be extended to the other

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature *No notice is taken of anonymous communications*]

Infra-red Spectrum of Diamond by Infra-red Spectrometer and Raman Methods

From the data given by specific heat, melting-point, and photoelectric effect, Einstein, Nernst, and Linde mann have deduced that diamond should have a frequency varying according to the method of calcula tion from 7 7 to 11μ

Spectrum obtained by Infra red Spectrometer

The infra red spectrum of diamond has been examined by the spectrometer by Ångström, Julius, and Reinkober, but without obtaining a complete state ment of the bands and without any attempt to determine their relationships Reinkober reported transparency where Julius found absorption We have also found and are investigating such an abnormal dia mond as that of Reinkober For seven normal diamonds, however, we find a band system in which there are apparently three fundamental frequencies and one combination band The wave numbers (cm $^{-1}$) for these bands have the following approximate values $\nu_1 = 1246$ cm $^{-1}$ = 8 02μ, $\nu_2 = 2086$ cm $^{-1}$ = 4 8μ, $\nu_3 = 2438$ cm $^{-1}$ = 4 10μ, and $\nu_1 + \nu_2 = 3353$ cm $^{-1}$ = 2 98μ On inspecting these fre quencies, it appeared at first that ν_3 might be a first harmonic of ν_1, but further consideration makes it much more likely to be one of the fundamentals required for the structure of diamond, which as Bragg has shown contains a six sided ring analogous to the benzene ring Three directions in this ring starting from a given carbon atom correspond to the ortho, the meta, and the para linkings of the organic chemist

From the geometry of the puckered hexagonal ring of Bragg the ratios of lengths of these linkings are as follows

1 1 63 1 91

It is to be remarked that the ratios of the fre quencies given above come out as follows

1 1 67 1 96

Spectrum obtained by Raman's method

We have also subjected diamonds to radiation by the Raman method in which the line λ4358 is selected in the manner suggested by Wood and have examined the spectrum Here we find a sharp line at λ4629 nearly The difference in wave numbers between this and the originating line is 1342 cm $^{-1}$, which is just inside the farthest out band at 8μ but not in the centre of this wide band We have also observed two diffuse bands, but these require further investigation

Robert Robertson
J J Fox

Government Laboratory,
May 1

Raman Effect in Diamond

From many points of view diamond is a crystal of supreme interest, and it is remarkable that, though more than two years have elapsed since the discovery of the Raman effect, no attempt appears to have been made so far to study the scattering of light in this substance I have found that quite a small diamond (half carat size) suffices to photograph the Raman spectrum of crystalline carbon Each of the mercury lines 4046 6 A and 4358 3 A excites a single Raman line of remarkable sharpness and intensity (Fig 1, marked with arrows), the wave number shifts are 1331 cm $^{-1}$ and 1333 cm $^{-1}$ respectively, in pleasing agreement with the wave number 1333 cm $^{-1}$ of the *Rest strahlen* frequency of diamond (Nernst and Lindemann, *Z Electro Chemie*, **17**, 822, 1911) The sharpness of the line is to be expected in view of the known perfection of the crystal, according to the ideas of Sir C V Raman (Faraday Society's Discussion, Bristol meeting) The brightness of the line is also not surprising in view of the ease with which organic substances generally give the Raman effect Experiment shows that the line is strongly polarised

The appearance of the Raman effect in diamond is specially significant in view of the fact that its crystal structure is not a molecular lattice but a continuously linked assemblage of similar atoms Other cubic crystals with a relatively simple structure, as, for example, sodium chloride, and sodium and lithium fluorides, which have been previously examined, have failed to exhibit any Raman lines Whether the difference between diamond and rock salt is due to the difference in their crystal structure, or due to the essential dissimilarity in the nature of the forces holding the atoms together in the lattice (homopolar in one case and electrostatic in the other) is a point which can only be settled by further research Reference should be made here to a recent interesting note by Clemens Schaefer (*Zeit für Physik*, **54**, 153, 1929)

Fig 1

Besides the two Raman lines, the spectrum shows also a diffuse band at 4155 A (marked with a dot), the origin of which is under investigation [The band is too faint to be visible in the reproduction of the photograph in Fig 1 —Ed Nature]

C Ramaswamy

Physics Department,
The Presidency College,
Madras, India,
April 10

Photoelectric Recording of Daylight

In a letter in Nature of Mar 1, 1930, Dr W R G Atkins and Dr H H Poole describe an apparatus for the photoelectric recording of daylight A photo electric daylight recorder has been in existence at the National Physical Laboratory, Teddington, for two years and has been utilised there since April 1929 for almost continuous recording, and a few further remarks upon this subject may therefore be of interest

In the first place, photoelectric recording of day light was first described by James E Ives [1] in 1925 and continuous recording has, it is believed, been taking place under his supervision at the Office of Industrial Hygiene and Sanitation, United States Public Health Service, Washington, since that time Ives used a thin film barium photoelectric cell—made by T W Case—in which a complex surface of barium, oxygen, and an oxide of barium is formed on aluminium Notwithstanding the fact that the thinness of the film and its complex nature makes these cells

much more sensitive to long wave radiation than those of pure barium in bulk—in probably the same manner as that occurring in the red sensitive potassium cells described by N R Campbell[2] and in the cæsium infra red sensitive cells referred to by L R Koller,[3] it was nevertheless found necessary to cover the aperture of the cell with a brownish yellow filter in order to compensate for the excessive blue sensitivity as compared with that of the eye The cell used was a large one, 2 inches in diameter and 5 inches long, with the result that the current was sufficient to be recorded with the aid of a Leeds and Northrup re cording potentiometer

The apparatus at the National Physical Laboratory is concerned with the measurement of visual daylight excluding sunlight, since it is skylight rather than sunlight which is of importance in the natural illumina tion of buildings At present, therefore—in order to exclude sunlight all the year round—the illumination has been recorded only from the north octant of the sky, but an apparatus is being constructed whereby that from each of the four octants (N , S , E and W) will be recorded and which will include an adjustable screen to cut out the strip of the sky which forms the sun's path

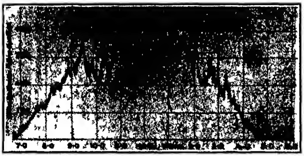

FIG 1

The measurement of illumination from definite areas of the sky involves the use of screens, the size of which governs the size of the aperture of the photo electric cell , so that the photoelectric cell used is a small one with a window only 1 inch in diameter The photoelectric current is of course also small and not large enough to operate a thread or pen and ink recorder Photographic recording is therefore em ployed

The cell used is a potassium hydride neon filled cell operated at 60 volts—or less in bright weather—and in consequence of the fact that it is used well below its glow voltage (180 v) the sensitivity remains remarkably constant A Wratten K3 filter is used in conjunction with the cell, and throughout the normal range of daylight colours this combination acts as if its colour sensitivity were identical with that of the eye

The cell is mounted on the flat roof of a high building together with the energising battery, and two long rubber insulated ignition cables lead to the recorder in a lower room Having the battery close to the cell enables the two long leads to be both at practically earth potential instead of one being at a potential about 60 v higher than the other, as would be the case if the battery were housed in the re cording room

The calibration is effected from the visual measurements made with an N P L illuminometer thrice daily (at 9 A M , noon, and 3 P M), and this method is found to be quite satisfactory

A photograph of a typical record for one day as obtained at the National Physical Laboratory is here reproduced (Fig 1)

Unless blue, violet, and near ultra violet daylight are to be recorded and the yellow and red light are to be neglected, the use of sodium cells as used by Atkins and Poole is not satisfactory, for such cells are insufficiently sensitive to red light even when used in combination with a coloured filter to reproduce the colour sensitivity of the eye The thin film potassium cells of the General Electric Company and the thin film cæsium cells of the British Thomson-Houston Company can both be used in combination with a filter to give a reproduction of the eye with regard to colour sensitivity with sufficient accuracy for daylight recording

The thread recorder, when it is possible to obtain photoelectric currents large enough to operate it, is to be preferred on grounds of economy to the photo graphic recorder

Since biologists are beginning to find it desirable to apply in their work the methods used in photo metry and in the solution of illumination problems, it would appear that the time is ripe for some degree of co operation and collaboration in these two branches of science

T H HARRISON
National Physical Laboratory,
Teddington

[1] Ives James E *Trans Ill Eng Soc* , N Y 20, p 498 , 1925
[2] Campbell N R *Phil Mag* , 6 p 633 , 1928
[3] Koller, L R *J Opt Soc Am* 19, p 135 , 1929

Effect of Hydrogen and Water on Radiation from Cyanogen-Oxygen Flame

IT is well known that hydrogen or water has a remarkable effect on the radiation from the carbon monoxide oxygen flame (Garner and Johnson, *Jour Chem Soc* , 280, 1928 , Garner and Roffey, *Jour Chem Soc* , 1123, 1929) When cyanogen is exploded with sufficient oxygen, the reaction is supposed to proceed in two steps, namely,

$$(1)\ C_2N_2 + O_2 \rightarrow 2CO + N_2$$
$$(2)\ 2CO + O_2 \rightarrow 2CO_2$$

(Dixon, *Jour Chem Soc* , 759, 1896) If this is the case, the radiation from (2) should be affected by the presence of hydrogen or water Dixon, on studying the ignition phenomena of these gases, concluded that water has no effect upon the combustion of cyanogen (*Jour Chem Soc* , 384, 1886)

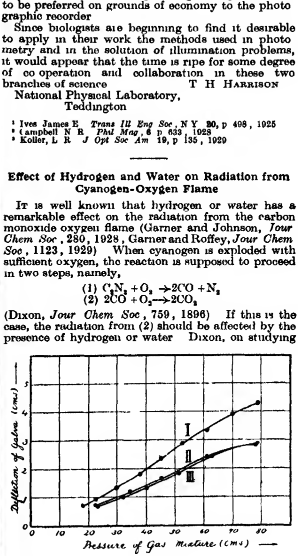

FIG 1

Recently, the total radiation from the explosion of cyanogen oxygen mixtures was measured in a bomb fitted with a quartz window (cf Garner and Tawada,

Trans Far Soc, 36; 1930), and a distinct difference between the dry and wet (that is, containing hydrogen or water) mixtures was found Curve I in Fig 1 shows the radiation from the dry mixture $C_2N_2 + 5O_2$, curve II that from a mixture containing 0 9 cm pressure of water vapour, and curve III that from a mixture containing 1 3 per cent of hydrogen It will be noted that hydrogen and water vapour have nearly the same effect, and this effect increases with increasing initial pressure The reaction velocity also appears to change with the addition of hydrogen

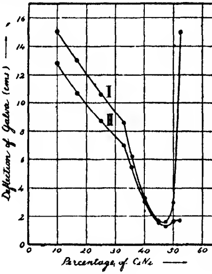

FIG 2

and water, since the explosion of the dry mixture is inaudible throughout the pressure range, whereas the explosion of the wet mixtures is distinctly audible at atmospheric pressure and may be heard even at 30 cm pressure

Fig 2 shows the variation of total radiation with different proportions of oxygen, the partial pressure of cyanogen being constant (3 75 cm) Curve I is for the dry gas, and curve II for the wet mixture (water vapour 0 8 cm) These curves also show that water vapour has an effect on the radiation emitted Its effect when more than 47 5 per cent of cyanogen is present is probably to prevent the liberation of solid carbon in the flame, and thus reduce the 'black body' emission In mixtures containing excess of oxygen, the reduction in radiation emitted is analogous to that occurring in the carbon monoxide flame

K TAWADA.

University of Bristol

The Ions Produced by Discharges at Liquid Surfaces

IN the *Proceedings of the Royal Irish Academy*, vol 39, Section A, No 3, under the above title, J J Nolan and J G O'Keeffe give an account of experiments showing that the ions which carry the discharge from liquid points have essentially the same mobilities as those present in discharges from metal points Some statements made by these authors regarding my early work on the same subject seem to imply that it is my contention that the current in such cases is carried altogether by minute droplets of liquid I do believe this to be true under certain conditions, but not as a general rule, for positive discharges especially can be produced from liquid surfaces without the formation of any droplets, and I have shown in a later paper (*Phys Rev*, 16, p 102, 1920) than those to which reference was made by the authors named that the main characteristics of discharges from liquid points agree very closely with those obtained with metal points of the same dimensions

Two widely different conditions may exist under which masses are torn from an electrified liquid surface Large drops are pulled off by the electric field when nothing is done to counteract the pull of this field upon the surface On the other hand, if this pull due to the field is neutralised by reduction of pressure inside of a droplet a condition of surface instability (see J Zeleny *Proc Camb Phil Soc*, 18, p 71, 1915 *Phys Rev*, 10, p 1, 1917) may arise during which a very fine thread of liquid is pulled out which breaks up into myriads of exceedingly small charged droplets

The manner in which this is brought about is as follows When an electrified hemispherical droplet is accidentally distorted, the place of increased curvature tends to move back to its former position owing to surface tension forces, and in addition it is acted upon by an increased electric pull in the outward direction owing to the surface density of charge being enhanced by this increase of curvature When the electric field is sufficiently great this latter effect predominates and a thread of liquid is pulled from the surface The potential at which this surface instability begins depends solely on the square root of the product of the surface tension by the radius of curvature of the surface

On the other hand, the voltage at which an electric discharge by gaseous ions begins depends on the pressure and nature of the circumambient gas as well as upon the radius of curvature of the drop For any given gas, therefore, it depends on the relative values of the surface tension and the gas pressure as to whether or not the surface instability will start at a lower voltage than the electric discharge It so happens that for a small water drop in air at atmospheric pressure the two effects are initiated at approximately the same potential Owing to the higher dielectric strength of carbonic acid, the surface of a like water droplet in this gas at atmospheric pressure becomes unstable at a much lower voltage than is required for initiating a discharge by gaseous ions, and it was found that the water surface began to lose its charge at a potential which was independent of the gas pressure over a considerable range of pressures

This behaviour is a characteristic of surface instability and not of a disruptive electric discharge For ethyl or methyl alcohol in air at atmospheric pressure, because of the much smaller values of their surface tensions, the surface instability also begins at a much lower voltage than does the electrical discharge It is in such cases alone and only for potentials near that at which surface instability begins that I believe I have proved that the electric transfer is carried solely by liquid droplets

JOHN ZELENY

Sloane Physics Laboratory,
Yale University, New Haven, Conn,
Mar 28

Water as an Activator of Luminescence.

IN the course of recent investigations on luminescence, it was noticed that many white salts showed, when wet, a bright blue luminescence under stimulation with a mercury vapour lamp, through a Uviol glass screen which excludes the visible region On drying the salts completely, the luminescence dis-

appears so that it appears to be due to the presence of water The phenomenon is very widespread, being noticeable with almost any white salt It is not confined to those salts which are appreciably soluble in water, silica, for example, showing the effect to a marked degree (this possibly accounts for the blue triboluminescence seen, for example, at the heels of a runner on wet sands at night)

In most cases there is also a phosphorescence lasting for some seconds after the extinction of the exciting light The spectrum, seen in a small direct vision spectroscope, appears to consist of a broad band with its maximum in the green at about 5500 A The colour of the luminescence with various salts is always some shade of blue varying from whitish blue to Italian sky blue, suggesting a variation in the spectral distribution in different salts

This phenomenon had a special interest for me in the light of other work recently carried out on the nature of the luminescent centre It has now been established by a number of workers in this field that the luminescence of inorganic salts is due to the presence in solid solution of a trace of an activator, for example, bismuth in calcium sulphide It has been shown by me (preliminary communication to the *Proceedings of the Leeds Phil Soc*, January 1929) that the relation between the brightness of luminescence and the atomic or molecular concentration of the activator is quantitatively accounted for by the hypothesis that the luminescence is due to the existence of centres consisting of one molecule or atom of the activator associated in solid solution with a definite number of solute molecules This leads to the relation $I = A c e^{-nc}$, where c is the molecular concentration of the activator and n is the number of molecules making up the luminescent centre Thus the existence of an optimum concentration is accounted for at the concentration $c = 1/n$

This relation has now been shown to be satisfied for various activators, bismuth, tin, lead, in calcium oxide, and also for uranin in aqueous solution Thus a determination of the optimum concentration gives the size of the centre

In the case of the luminescence activated by water, it was again observed that the brightness varied with the amount of water present, passing through an optimum or a number of optima It therefore appears that this blue luminescence is due to the association of water with the solid salts to form centres of a definite composition

Preliminary measurements on lithium fluoride show that there exist in this case two optima, corresponding to the existence of centres of the composition $LiF\ H_2O$ and $LiF\ 2H_2O$ It is hoped that further quantitative work on the luminescence activated by water will throw light on the nature of the association of water with the salts which it activates

J EWLES

Physics Department,
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Leeds

Do Glass Tubes or Rods Bend under their own Weight?

LORD RAYLEIGH, in his letter published in NATURE of Mar 1, directs attention to an experiment performed to answer the question, Do glass tubes or rods bend under their own weight? I have tried a similar experiment bearing on this subject, and the results may be of interest to readers of NATURE

The belief is current that glass tubes and rods of about 1 m length and 1 cm diameter, standing on end, will bend permanently under their own weight To test the idea a 110 cm length of glass tubing, 1 cm in diameter and 1 mm in wall thickness, was supported on horizontal supports 1 m apart The tube was loaded at the centre with a weight of 885 gm This weight was just a little short of the average weight necessary to break a number of tubes of the same diameter and wall thickness, from the same lot of tubing The percentage composition of the glass used was approximately as follows —SiO_2, 64, Na_2O, 8 5, K_2O, 5 5, PbO, 22

Young's modulus for this glass is 6400 ± 100 kgm/mm² and the tensile strength is 6 0 ± 0 5 kgm/mm² This experiment was started in March 1924 The tube selected was originally straight enough to roll on a flat surface After the lapse of six years there is a permanent deformation (with the bending weight removed) of 9 mm at the centre of the 110 cm length

Lord Rayleigh interprets the data obtained in his experiment as indicating that the permanent deformation (resulting from suspending a weight of 300 gm at the centre of a metre length of glass rod 4 9 mm in diameter, for seven years) was too small to measure In the experiment that I have described a large permanent deformation has been observed, but in this case the glass tube was stressed almost to its breaking point Both experiments lead to the same conclusion, that glass rods and tubes of mature age do not bend under their own weight

May I suggest that the common belief that laboratory tubing and cane glass will become permanently bowed if stood on end for a year or more can be explained in the light of the following consideration Until the introduction of the machine method for drawing tubing, about ten years ago, all tubing was produced by hand shops Hand produced tubing in lengths of 1 m is never perfectly straight—some of it is in fact badly bowed The individual sticks in a loose bundle of slightly bowed sticks of tubing, stood on end in the corner of a room or in a rack, will assume under the influence of vibrations and the occasional disturbances caused by withdrawing a stick from the bundle, a configuration strongly suggestive of permanent flow under gravitational force This is especially true if straight sticks enjoy first choice

C D SPENCER

Glass Technology Laboratory,
Incandescent Lamp Department,
General Electric Company,
Cleveland, Ohio,
Mar 27

The Crystal Structure of White Phosphorus

WHITE phosphorus crystallises in the cubic system Previous attempts to determine its crystal structure by X rays have not given positive results, notwithstanding its high symmetry As a matter of fact, white phosphorus at room temperature gives, by the powder method, poor photographs, showing very few weak lines

It has been also stated (H Joung, *Centralblatt f Min u Geol*, 107, 1926) that X ray researches on white phosphorus are impossible because of its transformation into the red modification by the action of X rays

We failed to observe any appreciable transformation under the action of X rays of long wave length, and have inferred that the difficulty of getting good photographs could be ascribed only to the imperfection of the crystals and to the remarkable thermal agitation of the atoms at a temperature approaching the melting point, similar to the behaviour of certain alkali metals, which give sharp interference lines only at temperatures much below their melting point

We experimented by dipping a glass capillary,

internally filled with liquid ammonia, in molten phosphorus and lifting it so as to have it coated with a thin layer of crystallised white phosphorus The capillary was then fixed in the axis of a Debye camera The temperature may be estimated at − 35° C

The photograph obtained with the K radiations of an iron anticathode shows 22 lines, which can all be arranged in the cubic system for a lattice constant of the elementary cell of 7 17 A Supposing the cell as containing 4 molecules P_4, the calculated density is 2 23, slightly greater than the data found in the literature at room temperature (values between 1 82 and 2 0)

The details of measurements and a discussion of the structure will be published elsewhere

Several authors have deduced from cooling curves that at lower temperatures (less than c − 70° C) another modification is formed, the form of which is still uncertain, since one of the authors describes it as hexagonal, and others as trimetric or monoclinic (P W Bridgmann *Jour Am Chem Soc*, **36**, 1344, 1914 D Vorländer, W Selke, and S Kreiss, *Berichte*, **58** B, 1802, 1925)

We repeated our observations, filling the capillary with liquid air The photograph obtained in such a way (at c − 170° C) shows a large number of lines which cannot be arranged in the cubic system

The dimorphism of white phosphorus is thus confirmed We cannot yet, on account of the complexity of the photographs, decide upon the symmetry of β phosphorus, but we incline to the opinion that it belongs to a system of rather low symmetry, at any rate we may conclude that it has a rather complex elementary cell Investigations are still in progress

G NATTA
L PASSERINI

Laboratory of General Chemistry,
Royal Polytechnic, Milan,
Italy, April 4

A Diamagnetic Simple Salt of Nickel

ACCORDING to the accepted views on atomic structure, the atoms of nickel, palladium, and platinum should, in the fundamental state, show the same outer electronic structure, namely, s^2d^8, where s denotes an electron with $l=0$ and d an electron with $l=2$ Spectroscopic evidence seems to indicate that, in the case of palladium, the electronic distribution corresponding to the fundamental state is d^{10} The magnetic properties of the compounds of these elements show great dissimilarity, for example, while $NiCl_2$ is paramagnetic and has a magnetic moment of about 14-16 Weiss magnetons, both $PdCl_2$ and $PtCl_2$ are diamagnetic (Bose and Bhar, *Zeit f Physik*, Vol 48, p 716) This difference was explained by these authors on the assumption that in $NiCl_2$ the two outer s electrons of the nickel atom are transferred to the two Cl atoms giving rise to a polar molecule, while in the other two compounds the two chlorine atoms are in covalent bond with the two uncoupled d electrons in the atoms respectively of palladium, or of platinum, thus neutralising the magnetic moments of these atoms It has, however, been found that both K_2PtCl_4 and $K_2Ni(CN)_4$ are diamagnetic

The magnetic similarity of these double salts of platinum and nickel made it worth while to investigate the properties of $Ni(CN)_2$ Mr Sushovan Dutt, working in this laboratory, has made the interesting discovery that while $Ni(CN)_2,7H_2O$ is paramagnetic, and has a moment of the same order as the other divalent simple salts of nickel, this compound shows a progressive diminution of paramagnetism with dehydration, and it has been possible to obtain a salt with magnetic moment less than 2 5 Weiss magnetons The salt is very hygroscopic, and in the process of transference from the desiccator to the sealed ampoule, into which it is introduced for magnetic measurements, it shows a perceptible change of colour There seems to be no reason to doubt that on complete dehydration the compound would be found to be diamagnetic

The observed facts can be accounted for on the assumption that, in the hydrated salt, one of the s electrons of nickel is transferred to each of the (CN) groups, giving rise to polar bonds, while in the dehydrated state the two (CN) groups are attached by covalent bonds to the two uncoupled d electrons of nickel This is an interesting illustration of how the nature of the valency bond in a compound depends on its state of hydration, and of the suitability of the magnetic method for testing such bonds in compounds of paramagnetic elements I am not aware of similar observations having been made before Further investigations are proceeding

D M BOSE

University College of Science,
Calcutta, Mar 28

The Problem of Stellar Luminosity

THOUGH I have the very greatest respect for any thing written by my friend and teacher Prof Eddington, I cannot see that in his letter in NATURE of Mar 29 he meets my arguments

Prof Eddington quotes a sentence of mine beginning "Similar considerations show " and says that I leave this assertion unsupported The considerations in question, which are of a simple physical character, are to be found in the two paragraphs immediately following the sentence quoted These considerations have nothing to do with evolution or secular changes occurring in Nature Prof Eddington has not discussed these arguments, though they are at the very basis of my line of thought

My earlier paper in *Monthly Notices R A S* (**87**, 708, 1927), discusses a density distribution in which the sinks of energy in the outer layers of the star exactly balance the source of energy in the inner portions, so that the luminosity of this density distribution is zero

The 'Humpty Dumpty' argument shows that the uranium model possesses a stable configuration, which is all that I require But my 'cooling' argument goes considerably further than this

The problem discussed by Prof Eddington in brief is given the mass M and the relative source distribution, to find the luminosity L in the steady state The problem I discuss (suggested by the uranium model) is given the mass M and the rate of generation L, to find the source-distribution in the steady state I do this by considering a range of density distributions, choosing those compatible with the arbitrarily assigned L and M and deducing the source distribution afterwards The conditions that the outer layers shall simultaneously enclose mass M and radiate to space at the rate L impose a restriction on the possible density distributions, the restriction depending on the surface opacity In this problem L is a *datum*, it depends neither on mass, radius, nor opacity The actual stars must be a subclass of the stars thus constructed The *observed* mass luminosity correlation must depend on the intrinsic nature of the energy generating process, it is not accessible merely from steady state considerations

E A MILNE

Wadham College, Oxford,
April 30

New Bands in the Molecular Spectrum of Hydrogen

IN the molecular spectrum of hydrogen, 3667 lines have been measured by Finkelnburg between λ4861 and λ3314, and Gale, Monk, and Lee have given a list of 3064 lines measured by them between λ3394 and λ8902 Of course, many of the lines in the two lists are common There are several hundreds of lines in the extreme ultra violet, first discovered by Lyman and later by Werner and Weizel Of this multitude of lines, only about a thousand have been classified by Richardson and his co workers, by Finkelnburg and Mecke, by Weizel, Hori, Dieke, and others Thus we still have to account for more than 75 per cent of the lines

Recently Richardson has given an account of all the levels which have so far been observed and also their interpretation according to Hund's theory of axial quantisation It appears that to account for such a large number of unclassified lines, some of the selection principles must be sacrificed, and the one that naturally suggests itself is that for the azimuthal quantum K, namely, that $\Delta K = \pm 1$ It is well known that this principle is violated even in the case of atomic spectra when a large electrostatic field is present, for example, in Koch's experiment on the production of $1P\ mP$ lines of helium, and in the recent work of Nils Ryde (*Zeits f Physik*, **59**, 836), in the production of forbidden lines corresponding to $\Delta K = \pm 2$, 0, in the spectrum of neon Since in molecule formation we have a very large electro static field coming into play, it may reasonably be expected that this principle will be completely vio lated

Working on this idea, I have been able to identify a number of bands due to otherwise forbidden transitions, for example, between the B level of Dieke and the a level of Richardson [$2p'\Sigma \leftarrow 2p\pi_a\ {}_b$] in Richardson's recent notation P, Q as well as R branches have been obtained for vibration frequencies $n = 0, 1, 2$ and $n' = 0, 1, 2$ The lines are mostly very weak It appears that a large number of lines otherwise not accounted for may be due to a similar cause

DATTATRAYA SHRIDHAR JOG
Physical Laboratory,
University of Allahabad, India,
Mar 8

Relation of Fluidity of Liquids to Temperature

IN reference to the editorial comment in NATURE of Mar 29, may I say that my letter of Feb 3 on the subject was communicated at the same time to the *Journal of Rheology* and appeared in its January issue in this country As you have stated, I was un aware that Prof Andrade was working on the sub ject His formula $\eta = Ae^{k/T}$, where η = viscosity, is obviously identical with the one which I proposed,

$$\log \phi = -\frac{k}{T} + A,$$

where $\phi = 1/\eta$, the fluidity As pointed out in my note of Feb 15, also published in NATURE of Mar 30, both of us were actually anticipated by Señor de Guzman and Prof C Drucker It is curious that such a con siderable lapse occurred in the recognition of what certainly appears to be the most satisfactory formula relating viscosity or fluidity of liquids to temperature I was led to it myself by the work of Stewart, Katz, Prins, and others on the X ray diagrams of liquids The existence of 'partial regional orientation' of the molecules in liquids suggests a partition into non-oriented and oriented species, the latter being regarded as slightly deformed Applying the Maxwell Bolzmann equation, in the form

$$\frac{N-n}{N} = e^{\,k/T},$$

where N = total number of molecules per unit space, n = number of oriented molecules,

and assuming that the fluidity is proportional to $\frac{N-n}{N}$,

then $$\phi = Ae^{\,k/T},$$

where A and k are constants

This derivation does not cover the actual mechanism of momentum transfer in liquids, and Prof Andrade's theoretical treatment of the subject will be read with great interest

S E SHEPPARD
Research Laboratory,
Eastman Kodak Company,
Rochester, N Y, April 14

The Exit Gas from an Ammonia Discharge Tube

WHEN ammonia is passed through a discharge tube, under the same conditions as used to prepare atomic hydrogen, an active gas is obtained This active gas is reducing in character as shown by the reduction of cupric oxide and of a zinc oxide-chromium oxide catalyst Small solid particles are heated to incan descence, a phenomenon often observed with atomic hydrogen The solid ammonia condensed in the liquid air trap (1 5 m from the discharge tube) gave an intense blue green glow when the active gas passed over it

If a substance like the zinc catalyst (which is known to remove atomic hydrogen) is placed in the gas stream, the glow in the trap is not affected This must mean that the glow is not caused by atomic hydrogen, and suggests that there must be at least one other active product present

Since the ammonia is broken up into hydrogen and nitrogen, there is a possibility that the exciting agent might be active nitrogen However, if am monia is allowed to condense in the trap and active nitrogen passed over the solid, the glow is not obtained Ammonia, when passed into the stream of active nitrogen, extinguished the yellow afterglow and caused the reappearance of the green glow in the trap

These experiments seem to indicate the presence of atomic hydrogen along with a nitrogen hydrogen compound, probably NH or NH_2, in the exit gas from the ammonia discharge tube We are continuing the work in an attempt to correlate the above with the ammonia synthesis and decomposition

G I LAVIN
J R BATES
Frick Chemical Laboratory,
Princeton University,
Princeton, N J, April 3

Light in Four Dimensional Space

WILL you kindly allow me to make a correction to my letter in NATURE of Feb 8

As dt is generally defined as the time co ordinate *after* correction for the ordinary velocity of light over the distance dx the equations are true for all cases, and it is therefore unnecessary to assume the velocity of light infinite even in flat space This and the fact that it becomes definitely a unit vector and loses the invariant character it possessed in the orthodox theory dispose of the suggestion that it might be a measure of the curvature of space Restated, the assumption made is that at any point of space the angle between a ray of light and the world line of its source is a constant

J HALCRO JOHNSTON
Orphir House, Orkney, Mar 26

Jean Baptiste Joseph Fourier, 1768–1830

WHILE the English school of physicists at the beginning of the nineteenth century was more concerned with experimental inquiries, the French physicists were rapidly extending mathematical analysis to many important physical problems. In this direction none achieved greater success than Jean Baptiste Joseph Fourier, whose "Théorie analytique de la chaleur" has long been a classic of science, and the centenary of whose death falls on May 16 of this year.

Laplace, we are told, was the son of a farm labourer; Poisson the son of a private soldier. Fourier also came from humble surroundings, his father being a tailor of Auxerre, where Fourier was born on Mar. 21, 1768. Yet Auxerre to-day claims Fourier as its most distinguished son and his statue stands in its midst. With poverty came misfortune, for Fourier was left an orphan while still a child, and the world owes something to the organist of Auxerre Cathedral, who proved a real friend to him. Next to the organist came the Bishop, through whom the boy was sent to the military school at Auxerre kept by the Benedictines of the congregation of Saint-Maur, and to the same school he returned as a teacher of mathematics after a short period of service as a novice of the abbey of Saint Benoît-sur-Loire.

As a boy, easily at the head of his class, from his youth Fourier proved a leader of men, and the Revolution found in him an ardent but prudent Republican. From that time onwards he was a man of mark, and whether as a professor in the newly founded École Polytechnique; whether as the companion of Napoleon during the Expedition to Egypt; whether as the orator chosen to give expression to the national grief at the death of Kleber and Desaix; whether as the energetic and practical prefect of the department of Isère or as the perpetual secretary of the Paris Academy of Sciences, he fully justified the good opinion of his early benefactors. Four years were spent in the École Polytechnique; three years in Egypt; thirteen years in Grenoble as prefect of Isère; and fourteen years in Paris.

Fourier's mathematical studies began in the school at Auxerre, where he was wont to steal down to the class room in the dead of night and pore over his books by the aid of candle ends secretly hoarded, and they were never again laid aside. Even when an administrator in Egypt, busily engaged with munition work for the army, or investigating the antiquities on the banks of the Nile, he found time to publish mathematical memoirs; while his great work on the theory of heat was written at Grenoble in 1812. The essay was written for a prize offered by the Academy of Sciences; it was applauded by Laplace, Lagrange, and Legendre, yet allowed to lie unpublished until 1822. His famous memoir has been described as a masterpiece of analysis, classing Fourier among the greatest mathematicians that ever lived. So early as 1835, Comte predicted that Fourier's analytical researches would be found of great use in other branches of physics, and this has proved to be true. Ohm was indebted to Fourier when searching for the law of conductivity of electricity; Kelvin used Fourier's mathematics when engaged with the Atlantic telegraph cable, and among Heaviside's papers was found a bill for a piece of music, with notes on his investigation of Fourier's work.

It was in 1816 that Fourier was first nominated for a seat in the Paris Academy of Sciences, but his election was not approved by Louis XVIII. Next year, however, the king reversed his decision, and five years later Fourier was chosen to succeed Delambre as perpetual secretary, his colleague being Cuvier. In this situation it fell to Fourier to pronounce the *éloges* on Delambre, Charles, and Herschel, for which he was given a chair in the French Academy. Widely respected, he died on May 16, 1830, and was buried in the Père La Chaise Cemetery, where lie the remains of so many of the most eminent men of science of France. His tomb is near that of Monge and also that of the Egyptologist Jean Champollion, whose youthful imagination had been stimulated by his conversations with Fourier at Grenoble.

Report of the Departmental Committee on Ethyl Petrol

THE Departmental Committee on Ethyl Petrol, the final report of which has recently been issued (H.M. Stationery Office, 1*s*. net), was appointed some two years ago, with Sir F. J. Willis as chairman, after anxiety had been expressed in Parliament and the public Press that the widespread use of motor spirit containing lead tetraethyl might form a possible source of danger to health. In the manufacture of this substance itself in the United States of America a number of deaths had occurred, and some fear was felt in Great Britain that the use of ethyl petrol, which contains approximately one part of lead tetraethyl in 650 parts of petrol, by weight, might be dangerous to the health of its users and of the public, notwithstanding that a committee appointed by the Government of the United States reported in 1926 that there were no good grounds for prohibiting the use of ethyl petrol of this composition as a motor fuel, provided that its distribution and use were controlled by proper regulations.

In July 1928 the Committee presided over by Sir Frederick Willis issued an Interim Report (H.M.S.O., 4*d*. net) after considering the experimental work carried out by the United States Government Committee and by the Ethyl Gasoline Corporation, and after hearing evidence from a number of distinguished witnesses. In this Interim Report the Committee expressed the opinion that the findings of the United States Government Committee were justified. But some of the results of the investigations carried out in

the United States, for example, the almost universal presence of lead in the urine of persons not exposed to lead risks, did not find complete acceptance in scientific circles even in the United States, and the Committee felt that these results might not prove to be true under the conditions of life in Great Britain, consequently, the Committee then reported that while it was superfluous to embark upon such an extensive investigation as had been carried out in the United States, yet it was desirable to confirm certain aspects in that work and elucidate others not covered by it Moreover, witnesses in evidence before the Committee had directed attention to possible dangers arising from the use of ethyl petrol, and the Committee drew up its programme of work with due regard to these features Possible dangers suggested by witnesses were injuries to health from the inhalation of lead tetra ethyl due to spillage, from the absorption of this substance through the skin, from the inhalation of lead dust in streets and in garages, and from the pollution of water supplies by soluble lead salts

In order to carry out its programme of investigations, the Committee acquired the services of three members of the staff of the Government Chemist, with Mr A G Francis as director of the research, for physiological work Prof W E Dixon of Cambridge gave his services, while the War Office staff at Porton co operated in carrying out the field experiments The following is a brief account of the principal sections of that programme

In the first place, the need was felt for a revision of methods in use for determining lead in traces accurately, and the method devised, which has definite advantages as regards this feature and also in saving of time, need not be described in detail, as it is published not only in the Report but also in the *Analyst* (p 725, 1929)

It was confirmed that lead is being almost uniformly excreted in the urine of subjects not exposed to lead risks, the average of 55 persons in London being 0 04 mgm lead (Pb) in a litre, a lower but still significant value being obtained from those living in country districts, while, in comparison, for 33 workers in an accumulator factory the average was 0 28 mgm in a litre In the last set of observations the quantity excreted was found by Dr R E Lane to run in line with the apparent risk of exposure and to agree with deductions from the appearance of the blood

Examination of fine settled dust in London and the surrounding country showed that it invariably contains lead in small quantities, residents in London are thus subjected to small daily doses of lead of approximately one tenth of a milligram, and this daily inhalation of lead is doubtless one of the causes, if not the main cause, of the almost universal excretion of lead in the urine of persons not exposed to a definite lead risk How far persons absorb lead from other sources seems to be a matter that would repay further investigation A systematic examination for lead in water supplies and food stuffs, particularly canned foods and beverages or condiments sold in vessels closed with metallic capsules, would probably show further cause for the presence of lead in the human system Very small quantities of lead taken in articles of food or drink are less objectionable than similar quantities of lead inspired into the lungs, because most of the lead taken into the alimentary canal is not absorbed but voided, whereas a greater absorption of lead takes place in the lungs

As fears had been expressed before the Committee that pedestrians, and particularly drivers and traffic policemen might suffer in health by breathing finely divided lead compounds derived from burning lead tetra ethyl in an engine, a very severe traffic block was simulated in a tunnel at Porton, 12 cars using ethyl petrol being employed, when the air at breathing level was examined for its content of lead At the same establishment experiments on several observers confirmed the value found in the U S A for the fraction of inhaled lead dust that is retained by the lungs (16 per cent under resting and 32 per cent under active conditions) From these two sets of observations it was possible to arrive at the value of 0 2 mgm of lead as a maximum absorption for a person exposed in close proximity to the rear of ten severe traffic blocks per hour during a 12 hours windless day As the accepted figure is 2 mgm per day for inhalation of lead to avoid chronic plumbism in the course of years, it is concluded that the risk from this cause either to traffic controllers or to pedestrians is negligible

Some witnesses having attributed risks to garage workers and to water supplies from lead containing deposits obtained in dismantling engines running on ethyl petrol, these substances were examined, but were found to be coherent in virtue of their oiliness, and not dusty With due regard, therefore, to ordinary cleanliness, it was not considered that a risk to garage workers is involved from these deposits either by inhalation or through the alimentary canal, nor on account of their insolubility was there any chance of contaminating water supplies

Although numerous experiments in the U S A had failed to show any ill effects of ethyl petrol when applied to either human skin or the skin of monkeys and other animals over long periods, the Committee resolved to follow up an observation made by Sir Robert Robertson in the Interim Report that while on evaporating isothermally ethyl petrol the first half contains no lead tetra ethyl, and a proportion distils off with the petrol in the succeeding fractions, yet the lead tetra ethyl is to some extent concentrated in the final portion As such a liquid as the last applied by Prof Dixon to the shaved skin of rabbits for 130 days gave no untoward effects, it is unlikely, keeping also in view the above mentioned experience abroad, that even garage workers whose skin is most prone to come into contact with used lubricating oil and with ethyl petrol can be regarded as being subjected to any danger

Spillage of petrol in garages formed the next series of investigations From what has been said, no ethyl petrol may be expected in the air of

garages until the ethyl petrol has been reduced to half its volume, but later, as it evaporates, it will be found in increasing quantities The extent of the concentration of lead found in the air depends on many factors, but, in practice, the four following have importance (1) the nature of the petrol with which the ethyl fluid has been mixed, (2) the quantity of ethyl petrol spilled and the frequency of spillage, (3) the surface on which the ethyl petrol is spilled, and (4) the ventilation of the garage

To determine the magnitude of the concentrations of lead tetra-ethyl likely to be found, in practice in the air of garages when ethyl petrol is spilled, conditions were chosen to represent the spillage of a single large quantity and the repeated spillage of small quantities of ethyl petrol in closed and open garages having floors made of four different materials, namely, asphalt, concrete, wood, and glazed tiles or bricks It was found that the concentration of lead tetra ethyl in the air was greatest when evaporation took place from a glazed surface and was least from asphalt Both concrete and asphalt retained lead tetra ethyl within their surfaces, thereby reducing proportionately the concentration of lead tetra ethyl in the air Increasing ventilation reduced both the concentration of lead tetra-ethyl in the air and the time during which lead tetra-ethyl was found in the air If a large quantity of ethyl petrol is spilled in an unventilated garage, significant proportions of lead tetra ethyl will be found in the air of the garage, but as the maximum proportion of lead tetra-ethyl found experimentally in the air under very severe conditions of spillage and ventilation was far below the concentration of lead tetra ethyl stated by Eldridge (United States Public Health Bulletin No 158, 1925, p 31) to be lethal for mice, the risk of danger to health appears to be small In an adequately ventilated garage, since the concentrations of lead tetra ethyl likely to be found in the air even when large quantities of ethyl petrol are spilled are less than that stated by the American investigators to have no effects on the weight, growth, or life of animals breathing it for three hours daily for several months, the risk of injury to health appears to be negligible

By far the greater risk, and one to which the Committee refers with emphasis, is that of carbon monoxide evolved in a badly ventilated garage

That the results of the work carried out by the Committee's experimental staff agree with those obtained by investigators in the United States of America is noteworthy, because the methods adopted in the two investigations were often dissimilar in principle From a consideration of all the investigations, whether carried out in America or in Great Britain, and of the evidence given by witnesses, the Committee concludes that the use of ethyl petrol of the present composition as a fuel for motor cars will not constitute a risk to the health of the general public or to that part of the population which is most exposed thereto, namely, garage workers, police officers on traffic control duty, and drivers of motor and other vehicles

Finally, the Committee does not consider that there are any reasons for prohibiting the use of ethyl petrol in Great Britain, but recommends certain precautions, such as labelling of the cans containing it, with a warning to avoid spillage and use other than as motor fuel, dyeing the liquid, and retention of a concentration of lead tetra ethyl not above its present limit

Landscape at the Royal Academy

By Dr VAUGHAN CORNISH

ONCE again, but unhappily for the last time, we see on the walls of the Royal Academy that rendering of chequered shade by which the late Mr H H La Thangue, R A, revealed the joyousness of sunlight, especially in Mediterranean lands, as in the picture "Packing Grapes" (120)

Outstanding among the studies of mountain scenery is "Cathedral Mountain from Lake O'Hara" (44), by Mr Richard Jack, R A Cliffs set with pine trees rise from still, dark waters, snow slopes, above, coldly grey, reach to the foot of the towering crag from which the mountain takes its name The deep shadowing of cyclopæan rocks harmonises with the sombre pines below The companion picture, "Lake O'Hara, Canadian Rockies" (243), in another room is carried out in the same manner, a fine interpretation of the solemnity of mountains and "the strength of the hills" "A Glen of Arran" (81), by Mr Guy Kortright, an assembly of mountain peaks strongly coloured in the full light of day, but stripped of atmosphere, is extraordinarily suggestive of silent solitude, so that the artist has been successful in his use of an extremely trying convention Mr Sydney Lee, R A, has a painting of "Sunset in the Mountains" (401), which shows huge turreted forms silhouetted in shades of deep purple against a glowing sky, one of the most deeply emotional aspects of the high mountains

Among the studies of the sea we come first to that of "Silver Moonlight St Ives Bay" (60), by Mr Julius Olsson, R A, in which a succession of long, low rollers sweep in silver foam over the shallows of a curving shore The lights of the fishing fleet, dimly discerned on the dark waters beyond, bring the human touch without impairing the elemental character of the scene, for the long shoreman is, in his occupation, still the primitive man whose work and sport are one In "Fresh Morning off the Scillies" (161), by the same painter, a study apparently made from a sailing boat, the waves, rising as high as the point of sight, produce the effect of size and power which is lost when they are overlooked from a lofty deck Thus seen, it is the sea which is the more massive element, the distant land, dimmed by the salt spray, appearing unsubstantial Mr Norman Wilkinson also pushes off in a boat, and thus gets full value from the waves in the only possible manner "A Newfoundland Fisherman" (359)

by him is a study of a companion boat, with hull rising above the line of sight, the wonderful curves of wind-filled sails cutting across a rain washed sky, the tumbling sea dark under the squall cloud hanging overhead Such pictures recall the adventure and the beauty which attend the sport of sailing, an occupation which, moreover, permits us to explore the scenery of our coasts and estuaries, which can never be fully appreciated from the land ward side alone

In "The Spey, Fochabers" (103), Mr S J Lamorna Birch shows great skill and knowledge in the treatment of the waters of a river which, within a short compass, has many varieties of motion

We cannot but deplore the scarcity of landscapes in which animal life is the focus of interest, but in Mr Arthur Wardle's "Under the African Moon" (164) we have at any rate one fine example The scene is the rocky desert, that stern landscape where man cannot live but has often gone to pray Seen in the monochromatic moonlight, the lion and lioness watching from the edge of the escarp ment are one in tone and colour with the back ground, the only contrast that of their rounded, supple forms against the rugged outlines of the rock If we had an unbiased appreciation of the beauty of living form, should we not give more attention to that of the great felines and relatively less to that of man? Granted that a man's hand is a much finer structure than the paw of a beast, yet when we examine the limbs we find a balance and rhythm in those of the lion and leopard of which biped man cannot boast

A word in conclusion on certain pictures which illustrate matters relating to that heritage of English scenery, the preservation of which, as was aptly stated in the *Times* of Friday, May 2, is becoming the subject of "a great national debate" "Midsummer Evening in Somerset" (279), by Mr Charles S Cheston, shows one of those splendid prospects of well wooded lowland which are seen from hills of no great height in southern England No native of a mountainous country looking up at these insignificant elevations would suppose it possible that they could provide such extensive views In Somerset itself we have a notable example in the low ridge of the Polden Hills, where a view-point of special interest has fortunately been secured and vested in the hands of the National Trust In "Blakeney from Cley" (766) Mr A Raine Barker has sympathetically rendered in smooth water colour a landscape of interest in relation to an important Nature reserve, which derives an old world charm from the great towers of the two village churches "Moel Siabod" (1257), a small aquatint by Miss Eveleen Buckton, gives a good impression of the wild scenery in that part of the ancient Snowdonia which, it is hoped, will soon be scheduled as a National Park

Mr Harry van der Weyden's large canvas, "From Ballard Down" (420), shows the beautiful waste of Studland Heath and a very interesting outline of coast and estuary in the mellow sunshine of late afternoon Access to this delightful bit of wild country has been lately made easy for the large resident and visiting population of Poole and Bournemouth, and this is for the moment a bene ficial event The beauty of the broad, open ex panse is, however, of a particularly vulnerable character, and its charm will vanish if it be built upon By all means let the many come and enjoy the heath, but let us hope that the corporations of Poole and Bournemouth will realise that, as Beachy Head stands to Eastbourne, so does an unspoilt Purbeck stand to their towns, an extra mural asset of financial as well as sentimental value

Obituary

PROF GEORGE A GIBSON

PROF GEORGE ALEXANDER GIBSON, whose death at Scotstounhill, Glasgow, on April 1, we greatly regret to record, was born at Greenlaw, Berwickshire, on April 19, 1858 His father, the late Mr Robert Gibson, was highly respected throughout the Greenlaw district as a leader in ecclesiastical and political affairs

Prof Gibson was educated at the local Free Church school, from which he proceeded straight to the University of Glasgow, where he won high dis tinction in classics, English literature, and philo sophy, as well as in mathematics In 1882 he gained the Euing fellowship in mathematics and natural philosophy, and in the following year he was appointed assistant to Prof William Jack, who then held the chair of mathematics During the succeeding twelve years he established his reputation as an enthusiastic and capable teacher, and was responsible for the initiation and conduct of numerous courses on advanced mathematics, which were of great service to the honours students

In 1895, Prof Gibson was appointed professor of mathematics in the Glasgow and West of Scotland Technical College, where he remained until 1909, when he returned to the University of Glasgow as successor to Prof Jack During his period at the Technical College notable developments took place in the aims and scope of the work of that institution, and in all these Prof Gibson took an outstanding share, thus earning the gratitude of his colleagues and of the governors of the College

On returning to the University, Prof Gibson took the opportunity to reorganise the mathematical teaching there, tutorial instruction was provided for all the students, and the curriculum was widened and extended After the War the number of students rose to 900, but in spite of all difficulties the high standard of the work was maintained

Prof Gibson was a great teacher who loved his work, and for whom the interests of his students were paramount He was also an eager and tireless student, with a remarkably wide and thorough knowledge of mathematical literature He became a recognised authority on certain parts of the history of mathematics, and wrote numerous papers on the origins of the calculus and on the great Scottish mathematicians He was the author

of several well known text books, the most notable being his "Elementary Treatise on tho Calculus", a standard work extensively used throughout the British Empire After his resignation in 1927 he prepared a large and important volume on advanced calculus, which is at present passing through the press Many books, written by members of his staff, have also benefited by his profound learning and long experience, always freely and generously placed at the service of younger workers In the Edinburgh Mathematical Society, which he joined soon after its foundation, Prof Gibson was a leading figure, and a frequent contributor to its publications From 1917 until 1920 he held the office of vice president of the Royal Society of Edinburgh The Universities of Edinburgh and Glasgow both conferred on him honorary LL D degrees, the former in 1905 and the latter in 1927

An enthusiastic administrator, Prof Gibson rendered important services to the cause of education in Glasgow He was one of the original members of the Glasgow Provincial Committee for the Training of Teachers, after returning to the University he became a governor of the Technical College, for a long period he acted as chairman of the governors of the Park School Company, and in the Senate and University Court his sound and forceful counsels carried great weight with his colleagues On the occasion of his retirement his friends and students combined to testify to their respect and admiration by raising a fund for the endowment of lectures on the history of mathematics, to be given at intervals in the University of Glasgow, and to be known as the George A Gibson Lectures

T M M

Dr David Draper

In September of last year David Draper, one of the oldest of South African geologists, passed away at the ripe age of eighty years He was well known throughout the land as the founder of the Geological Society of South Africa in 1895 He was born in the Cape Colony in 1849, and was the son of one of the English settlers who came out to South Africa in or about the year 1820 Most of Dr Draper's schooling was done at Colesberg in the Cape Colony, which place he left whilst still in his teens to join the small army of diggers occupied in opening up the diamond mines of Kimberley in 1868 After taking an active part in this work with a fair amount of success, he departed for the Lydenburg and Barberton Gold Fields, which he closely studied, and later settled for some years in Natal, where he made himself acquainted with the extensive coal fields of that colony The richness of the gold mines of the Witwatersrand afterwards drew Dr Draper thither, and one of his first commissions of importance was to unravel the geological section from Vereeniging to the norite 'Pyramids' north of Pretoria on behalf of the local Chamber of Mines This work, which covered an entire section of the Witwatersrand beds, was successfully accomplished and has stood substantially correct to the present day

It was about this time that Dr Draper realised the necessity of furthering the work of geologists, mining men, and prospectors in South Africa, and the result of his efforts was seen in the formation of the Geological Society of South Africa In addition to being the founder and first secretary and treasurer of this Society, it is interesting to note that he was also the first South African born fellow elected to the Geological Society of London

One of Dr Draper's first efforts for the South African Society dealt with the primary systems of South Africa, and the conglomerate beds of the Witwatersrand, which at that time were creating world wide interest on account of their unique geological features and richness as gold bearers From this time on Dr Draper was an ardent worker in the field of geology, and visited such distant parts of the world as Borneo, Asia Minor, and Brazil on special geological excursions Some of his most useful contributions relate to the diamond occurrences of South Africa and Brazil

For the valuable services rendered to the science of geology in South Africa, Dr Draper was made an honorary life member of the Geological Society of South Africa—a distinction conferred only twice on South African members during the existence of that Society In 1927 the honorary degree of doctor of science was conferred on him by the University of the Witwatersrand

The contributions to geological science by Dr Draper were numorous, and a bibliography of his works, compiled by the present writer, contains no less than fifty seven papers to scientific societies and the technical press in various parts of the world

Harold S Harger

Dr Albert von Le Coq

A dispatch from the Berlin correspondent of the *Times* which appeared in the issue of April 25 announced the death of Dr Albert von Le Coq, the famous German explorer and archæologist, at the age of sixty nine years Dr Le Coq was a native of Berlin, and for some time was director of the Museum für Völkerkunde in that city He was, however, best known for his investigations in Central Asia

In 1904 and 1905, Dr Le Coq made two expeditions of archæological exploration in the area at the foot of the eastern Tian Shan Mountains in the neighbourhood of Kurfan and Koria On one of these he was accompanied by Dr Albert Grunwedel, the well known authority on Buddhist art and archæology As a result of the excavations in the sand-buried city ruins in the area, a large number of Buddhist wall paintings and other relics were discovered and brought back to Berlin The most important discoveries, however, were a large number of documents written in a variety of alphabets on Chinese paper, vellum, and wood Not only did these reveal links between Hellenism, Persia, India, and China, but more important still it was found that a new and hitherto unknown Aryan language with two distinct dialects had been discovered Study of Tocharian, this new language, has since revealed that it differs in phonetics, vocabulary, and

structure from all other of the Asiatic Aryan languages and belongs to the western or *centum* group of Aryan

Dr Le Coq's most important book described his work in Asia under the title "Buddhistische Spätantike in Mittelasien" A semi popular and well illustrated account of the results of his excavations was published (1928) in English under the title "Buried Treasures of Chinese Turkestan" In 1906, Dr Le Coq was awarded the medal of the Order of St John of Jerusalem, struck in gold for the first time, for saving the life of Capt (now Brigadier General) J D Scherer while on a journey in Central Asia in circumstances of exceptional difficulty Dr Le Coq was an honorary fellow of the Royal Anthropological Institute of Great Britain

WE regret to announce the following deaths

Prof J Wemyss Anderson, who was John William Hughes professor of engineering refrigeration in the University of Liverpool from 1920 until he retired in 1924, aged sixty one years

Prof Mary Whiton Calkins, professor of philosophy and psychology at Wellesley College, past president of the American Psychological Association and of the American Philosophical Association, who was one of the first to establish a psychological laboratory, on Feb 27 aged sixty six years

Dr H J B Fry, pathologist to the Research Institute of the Cancer Hospital and honorary secretary of the Investigation and Scientific Advisory Committees of the British Empire Cancer Campaign, on May 5

Lieut Col H H Y Hearsey, formerly Principal Medical Officer of Nyasaland, known for his work on blackwater fever, on April 30, aged sixty three years

News and Views

THE latest *Bulletin of the Geological Society of China* (vol 8, No 3, 1929) contains three memoirs which supplement the information given in the earlier *Bulletin* (vol 8, No 1) already discussed in NATURE of Mar 22, p 448) with reference to the discovery of an almost complete brain case of *Sinanthropus* by Mr W C Pei on Dec 2, 1929 Father Teilhard de Chardin and C C Young give an account of the geographical and geological conditions at Chou Kou Tien and a summary of the evidence which goes to establish the fact that the place where the fossil remains were discovered was once a limestone cave actually occupied by Peking man at a period later than the Pliocene and earlier than the loess They suggest that the age of all the fossils is Lower Pleistocene Vast quantities of fossilised remains of animals associated with *Sinanthropus* were found The identifications of these are given in the report and the palæontological evidence for the determination of the period is set forth with great clearness

THE discoverer of the skull of *Sinanthropus*, Mr W C Pei, gives an account of an event which is perhaps the most significant, if not the most momentous, in the history of human palæontology, and Prof Davidson Black gives in print the account of the skull, which was reported (from his manuscript) in NATURE of Mar 22 His memoir, however, is illustrated with a series of nine plates giving full size photographs of some of the stages in the long and difficult task of removing the hard matrix of travertine from the skull This was successfully completed during the week when the *Bulletin* was published (two months after the reports it contains were written), and then was revealed the unexpectedly simian type of temporal bone in association with a peculiar type of parieto occipital conformation hitherto unknown in any other human skull with the solitary exception of the Piltdown skull in its correctly reconstructed form

BY the courtesy of Prof J L Myres, secretary of the Seventeenth International Congress of Orientalists, we have received a copy of correspondence with the Secretary of State for the Colonies covering a schedule of facilities to be extended to archæological expeditions in Palestine which have now been approved by the Secretary of State for the Colonies and are in force as from April 1 of the current year The facilities and privileges in question will be granted by the Palestine Government to all archæological expeditions in possession of a valid licence to excavate in Palestine in accordance with the provision of Section 9 of the Antiquities Ordinance of 1929 It will, however, be necessary as a preliminary to the grant of any facilities that the holder of a licence should produce a statement by the Director of Antiquities that the expedition has been approved by the High Commissioner for the purpose of exemption and other privileges The privileges, which are set forth in detail in the schedule together with the procedure to be followed in each case to secure their operation, are liberal and varied They have been drafted with great care and a full knowledge of the difficulties arising out of legislative and fiscal regulations which beset archæological expeditions Further, and this is even of more moment, they evince on the part of both the Palestine Government and the Colonial Office a sympathy with and interest in archæological exploration which are gratifying and encouraging to those concerned with the promotion of archæological study in the field

THE facilities granted affect both the results of archæological exploration in Palestine and the personnel of the expedition Most important under the first head is the regulation that export Customs fees will be remitted on antiquities allotted to the holder of a licence as a result of the division with the Department of Antiquities of the objects found, while import Customs duty is remitted on instruments and scientific appliances needed for the purpose of excavation and archæological study, as well as on camp and other equipment for the expedition This applies whether the articles are imported by sea, air, rail, or parcel post Reduction in railway fares is granted to all members of the expedition including half fare reduction of third class fares for labourers In the case of skilled labour imported from Egypt, however, it must be shown that suitable labour is

not available in Palestine Both archæological equipment and antiquities are entitled to a reduction of freight on the basis of one half the full rates on passenger train and according to scale on goods trains In order to minimise any difficulties which might arise under the immigration regulations, the normal procedure to obtain visas for members of the expedition and for such labourers as cannot be engaged in Palestine is to be simplified On receipt of a statement in advance by the holder of a licence, the Director of Antiquities will issue a certificate to the Chief Immigration Officer, who will thereupon issue the necessary visa authority to the consular authority concerned No remission of immigration fees will, however, be granted The simplicity of the procedure in each case should ensure the smooth working of the regulations They have been framed on such broad lines and in so friendly a spirit that expeditions in Palestine should be able to work with little, if any, of the 'red tape' difficulties which have often proved an embarrassment to archæological study in other countries

A REGULAR telephone service between London and Australia was inaugurated on April 30 At the English end the transmitting station is at Rugby and the receiving station is at Baldock, Hertfordshire The corresponding Australian stations are Pennant Hills for transmitting and La Perouse for receiving, both in the neighbourhood of Sydney The two links are combined and controlled at the London Trunk Exchange and the Sydney Telephone Exchange From these points access is obtained to the land line telephones of the two countries The path of the voice from an English subscriber to Sydney goes first to the London terminus It next goes over 85 miles of land line to Rugby, and then goes over the radio link of 11,000 miles to the station at La Perouse, seven miles from Sydney From there it goes by the land line to the Sydney terminus and thence to the listener in Australia When the Australian speaks it goes to the transmitting station at Pennant Hills, then the radio link to Baldock and back to London, which is connected to the subscriber by his telephone wire The first official conversation was between the Prime Ministers of the two countries, and was broadcast both in Great Britain, at 8 30 A M, and in Australia, and was heard very clearly About an hour later the private conversations got blurred owing to 'fading' This was attributed mainly to an atmospheric disturbance taking place in the Indian Ocean

THIS new radio link connecting Rugby and Sydney, 11,000 miles long, is much the longest in the world The length of the Buenos Aires to Madrid public telephone link is 6400 miles On April 3 a radio link 5300 miles long was opened connecting Buenos Aires to Netcong, N J, in the United States These lengths make the telephone link between England and America, 3200 miles long, comparatively short Five continents are now connected by telephone It is possible, for example, for a subscriber in Santiago, South America, to talk to anyone in Ceuta, Africa His voice would first pass over the wires crossing the Andes to Buenos Aires, then to Netcong by radio, and by wire to New York From there it would go to Rocky Point, Long Island, and by radio to Cupar, Scotland, then by wire to London and by submarine cable to Boulogne After going through Paris, Madrid, and Algeciras, it would go under the Straits of Gibralter by a submarine cable to its final destination It could also have been sent direct from Buenos Aires to Madrid It is instructive to note that the messages sent from New Jersey to the Argentine can be sent by one of three different wave lengths It has been found that although one may be badly affected by atmospherics, another may be scarcely affected at all

Now that the telephone service is so widely established, and seeing that its usefulness is continually increasing, the Post Office engineers might be excused if they regarded somewhat coldly other methods of communication Like the ancient Athenians, however, they are always seeking after some new thing The latest development is a teleprinter service for subscribers through telegraph exchanges We learn that the first exchange will be in working order about the end of the year The new service will be operated in a somewhat similar way to the telephone service When the operation is completed, two subscribers will be able to telegraph typewritten messages to one another Each subscriber will be provided with a teleprinter, the use of which can easily be mastered by a typist, and will be allotted a number By depressing a button the exchange operator is called and the required number will be dialled to him When the required connexion is made, 'thro' will be typed on the teleprinter The subscription to the exchange which is at present contemplated is of the order of £70 a year and will cover the installation and maintenance of the lines and instruments and all communications with other subscribers on the exchange Additional instruments can be hired at a cost of about £50 a year At the outset, the new service will be confined to the London area, but we expect that it will develop so as to cover many of the larger centres This innovation will make telegraphy more popular, as it will obviate the necessity of sending telegrams to a public office for dispatch The first exchange will be in the Central Telegraph Office It is hoped that subscribers will be able by this means to forward telegrams for dispatch by all telegraph companies and to receive their incoming telegrams directly on their teleprinter instruments

THE Safety in Mines Research Board has just issued Paper No 58 (London H M S O) dealing with the use of steel pit props in collieries, as usual, the publication is issued at an uneconomic price, namely, one shilling, in order that it may be as widely read as possible in the coal-mining industry The report is signed by Messrs Ashley, Dixon, and Hogan, the first named is one of H M Inspectors of Mines, who has been employed as a practical investigator on behalf of the Board, whilst Prof Dixon and Dr Hogan

are well known research workers The report points out that the value of steel arches for roadway support has been proved beyond doubt, and that steel props have been successful at the working face under a large number of conditions, it being necessary, however, that the type of prop selected should suit the particular conditions at the coal face Some thirteen different forms of steel props are here fully described, together with the results obtained with them both in actual practice and under test, and a comparison of these props with ordinary Norwegian wooden round props is also appended As regards the practical side of the question, it is shown that although the first cost of a steel prop is much higher than that of a wooden prop, the use of the former has been attended with very marked savings, which in one case is said to be as much as 9d per ton of coal compared to the cost of timber

PERHAPS the most interesting section of this report on steel pit props deals with the effect of the use of steel props on the accident rate, and the results are summed up in one sentence "Where steel props have been used in Great Britain there has been a marked freedom from reportable accidents from falls of roof" Another interesting sentence states that "At Ashington Colliery, Northumberland, very few reportable accidents have occurred where steel props are in use" It will be remembered that a few months ago the miners at Ashington were prepared to come out on strike on the ground that the steel props used by that colliery company were a source of danger, and this authoritative statement to the contrary shows how absolutely without foundation was the above contention of the miners, and sheds light upon the trivial pretexts which are at times made the basis of a proposed strike

BRIGHTLY coloured mock suns were seen from a number of places, including London, on the afternoon of May 1 last The phenomenon is not often shown with sufficient brilliance in these latitudes to be obvious to the casual observer, and were it not for the fact that at places where a regular watch has been kept for it with certain optical aids, for example, at the Radcliffe Observatory, Oxford, it is observed on a considerable number of occasions in an average year, the phenomenon would be regarded as distinctly rare outside the polar regions These mock suns showed characteristic horn like projections away from the sun along the space appropriate for the mock sun ring, and occurred in connexion with the ordinary halo of 22° radius A sun pillar was present, and an upper arc of contact—a bow of light making contact with the 22° halo, the convex side being towards the sun The ice crystals in the upper atmosphere that caused the display were due to the presence of cirrus cloud connected with a system of depressions over southern Europe, and some turret cloud (alto cumulus castellatus) was visible in London later in the day Neither form of cloud is suggestive of settled fine weather, and, in spite of the presence of a large anticyclone centred over Scotland, thunderstorms broke out in southern England within twenty four hours of the occurrence of the mock suns

IN his Friday evening discourse delivered at the Royal Institution on May 2, Mr H E Wimperis, Director of Scientific Research, Air Ministry, discussed the present state of our knowledge of the phenomenon of spin in aeroplanes The motion of an aeroplane in a circular path is just as steady and just as normal as that of straight flight Even in the most troublesome form of spin, the aeroplane cannot be charged with behaving in any but a purely normal and quite virtuous way Our efforts must therefore be directed not towards the curing of a supposed fault but at making this particular form of stable motion as controllable at the will of the pilot as any other of the machine's forms of motion With the aid of models and kinematograph films Mr Wimperis illustrated the growth of the forces which make for autorotation of the wings and so lead to the ordinary spin, and of the centrifugal forces in the various aeroplane parts which tend to raise the nose of the machine into the 'flat spinning' attitude and definitely oppose the pilot's effort to get the nose down and so resume normal straight flight A detailed study is being made of the various ways in which the pilot's controls can be so strengthened as to make him always able to overcome these autorotation and inertia forces This study is being carried out by the use of model aeroplanes which are either observed and photographed when spinning, or are held in spinning attitudes in a wind tunnel so that the forces acting upon them can be measured At the same time, full scale experiments in free flight are being undertaken so that records can be made by instruments of the nature of the motion in each of the various types of spin

AT the annual meeting of the Royal Institution held on May 1, the report of the Committee of Visitors for the year 1929 was read and adopted, and the following officers elected *President* The Duke of Northumberland, *Treasurer* Sir Robert Robertson, *Secretary* Major C E S Phillips The alterations which are being made at the Royal Institution occupy a prominent position in the report of the Committee of Visitors Plans are shown of the rebuilding now in progress, which has been undertaken at an estimated inclusive cost of £80,000 As is well known, the chief alterations have concerned the lecture theatre, the shape, size, and general aspect are being preserved so far as possible, but there will be greatly improved arrangements for entry and exit, increased comfort and additional lecture facilities, with full provision for the display of kinematograph films A range of lighted show cases is being constructed round the semicircular corridor beneath the theatre tiers for the display of some of the Institution's historical apparatus During the building operations, the principal pieces of apparatus used by Rumford, Davy, Faraday, Tyndall, and Dewar have been placed on exhibition at the Science Museum, South Kensington As the

result of a private appeal, generous donations towards the costs of reconstruction have been received from individuals, City Companies, and electrical and chemical industries which owe their existence to the scientific work carried out at the Royal Institution With the sale of the American MSS known as the Dorchester Papers, the total receipts have been nearly £49,000 It is proposed to issue a wider appeal for the remainder of the money, and also for an endowment fund for research in the Institution and the Davy Faraday Laboratory, in connexion with the celebration of the centenary of Faraday's discovery of electromagnetic induction The Faraday celebrations will begin on Sept 21, 1931, and the centenary meeting of the British Association will open in London on Sept 23

WE have already referred to the increased interest being taken in the study of natural history in China Fresh evidence of this movement is afforded by the publication of the first number of the *Hong Kong Naturalist*, a quarterly illustrated journal for Hong Kong and South China, to be devoted to the description of features of the fauna and flora of South China and neighbouring countries The first number indicates the character of the magazine—a combination of more general articles for the non expert and of more technical studies for the trained naturalist Amongst the former are instalments of accounts of the birds, orchids, and ferns of Hong Kong and, specially to be commended, a simple diagrammatic scheme indicating the months when the nests of different birds may be found The special articles include the beginning of a synopsis of the fishes of China Some experience of magazines with such a twofold aim, however, suggests the warnings that continued articles which run through endless numbers are not popular, and that for the general naturalist systematics is often a bore Biological studies, life histories, up to date summaries of modern points of view, should not be forgotten They are equally scientific, have more interest, on the whole, for the general reader, and should tend to turn the attention of local field naturalists to profitable and more congenial lines of observation Already, we understand, a gratifying demand for the new magazine has been received, and we wish it all success

IN a recent issue of *Helios*, the German electrical journal for export use, which is printed in German, French, and English in parallel columns, there is an interesting article by E Schwandt on automatic signalling for railway level crossings The railway track for a distance of 300 yards on each side of the level crossing is insulated When the train is on the insulated portion of the track, a local circuit is completed and the white lights from the lamps at the gates on both sides of the crossing being automatically screened show red When the last carriage leaves the insulated track, the lamps give white light For greater safety, instead of having a steady red light, intermittent flashes of white and red light can be given, the white flashes lasting longer than the red ones The Berlin Municipal Railway has already adopted this method The German Automobile Club has also taken up the problem of the best way to illuminate railway gates In Germany, the level crossings in the country are often very inadequately illuminated Sometimes even an oil lamp hung from the middle of the gate is considered sufficient This can very easily be concealed by a cart standing in front of it To obviate this danger it has been proposed to place on the gates sets of two or three lamps which give an intermittent light when the gates are closed They are arranged so that it is practically impossible for all the lamps to be concealed from oncoming traffic at the same time It would be an expensive undertaking to fit all unprotected crossings in Germany with warning signalling apparatus The advisability of such devices is universally admitted, but it is not clear whether the State railways or the highway boards should bear the great expense of installing them

THE forty first congress of the Royal Sanitary Institute will be held at Margate on June 21–28, under the presidency of the Right Hon Lord Cornwallis The sections and their presidents are as follow Preventive medicine, Sir Andrew Balfour, engineering and architecture, Sir Henry Maybury, maternity and child welfare, including school hygiene, the Lady Howard de Walden, hygiene of food, Mr H Williams, hygiene in industry, Mr F W Goodenough, veterinary hygiene, Major General Sir John Moore Conferences of sanitary authorities, health visitors, and others will also be held Among the subjects to be discussed are psittacosis, maternal mortality, public health service and school medical inspection and treatment, health of industrial workers, education of the health personnel, inspection of food-stuffs, food in relation to dental hygiene, and regional control of sewage purification works Dr O Charnock Bradley, principal of the Royal (Dick) Veterinary College, Edinburgh, will deliver the Congress lecture, taking as his subject "Diseases of Domestic Animals from the Human Angle", on Tuesday, June 24 A feature of the Congress will be the visit of two hundred representatives of the American Public Health Association An exhibition of appliances for the promotion of public health and sanitation has also been arranged

THE German Association for Natural Science and Medicine has visited in recent years Innsbruck in the south, Dusseldorf in the west, and Hamburg in the north This year the Association will proclaim science and civilisation at Konigsberg in the far east of Prussia The invitation circular is not to members of the Association alone, but also to all who honour German science, and makes welcome the participation of foreign savants who feel themselves in contact with German research This ninety first assembly of the "Gesellschaft Deutscher Naturforscher und Aerzte" takes place on Sept 7–11, 1930 There will be general addresses, a short programme of sectional meetings, and numerous joint discussions Festivities are to be limited in favour of the call of learning The main topics include protoplasm, bird migration, logic and

natural science, the natural system of the elements, agriculture, and economics. The medical side will discuss blood pigments and bacteria, and will combine with biologists to discuss inheritance and with physicists to consider the eye. Joint discussions will deal with the cosmic frequency of the elements, the age of the earth, the synthesis of silicates and cosmic radiation. Botanists and agriculturalists will discuss meteorology. Various allied scientific societies are holding their meetings at the same time and place. The programme of excursions includes the neighbouring sand dunes, lagoons, bathing resorts, fresh water lakes, and historic monuments. Longer journeys include Finland for mineralogists before the meeting, and after the meeting Leningrad and Moscow. Königsberg can be reached from Berlin without any further visa, passport, or tax; eight times daily by train in 9-10 hours; by fast motor ship *via* Swinemunde-Zoppot-Pillau, 18 hours at sea; also thrice daily by air in 4-5 hours. The subscription for those attending the meetings, but not regular members, is 25 rm.; applications should be sent to Secretary G.D.N.A., Prof. Dr. Rassow, Leipzig C 1, Gustav Adolfstr. 12, and if possible by mid-May by those wishing to join excursions.

THE report on the work of the National Illumination Committee of Great Britain, presented by the chairman at the annual special meeting on Jan. 30 last, which has recently been issued in pamphlet form, illustrates the widening activities of this Committee. Following recent international congresses, a considerable number of sub-committees has been formed, and a brief summary of the proceedings of each is presented. Amongst such sub-committees those dealing with coloured glass for signal purposes, traffic control signals, daylight illumination, colorimetry, lighting education, definitions and symbols, automobile headlights, factory and school lighting, street lighting and aviation lighting may be mentioned. In five cases the British committee has assumed secretariat responsibility, which involves the collection of information from abroad. The work of the Illumination Section of the British Engineering Standards Association, which is closely allied to that of the National Illumination Committee, is also reviewed. Technical committees dealing with nomenclature and definitions, lighting fittings, street lighting, electric lamps and optical projection apparatus are mentioned. Preparatory work in connexion with the International Illumination Congress to be held in Great Britain in 1931 is actively proceeding. Judging from the developments summarised in this report, Britain should be able to present an impressive record of work done.

THE tenth Report of the Committee of the Institution of Civil Engineers which is investigating the deterioration of structures in sea water has recently been published by H.M. Stationery Office (2*s*. net). It follows now familiar lines, recording the progress of the numerous test specimens exposed in various harbours of the world. Tests of iron and steel bars which have been corroded for five years at Plymouth showed that the interior of the metal was unaffected, normal tensile tests being obtained after machining off the corroded surface. Heat treated and polished bars of chromium steels were found after five years to be deeply pitted by sea water, although the polish remained perfect between the pits. Similar bars were quite unaffected by exposure to air or fresh water for the same time. Of the numerous tests made to determine the protective effect of different paints, mention should be made of the high degree of protection given by a coat of white lead over tar, such plates being in perfect condition after 17 months at half-tide level. Of the experiments on wood a remarkable result is the very high concentration of arsenical compounds necessary to protect against *Teredo*. The addition of naphthalene to creosote appears to be of advantage. The behaviour of concrete is to be studied by means of a further series of test specimens.

THE first conversazione this year of the Royal Society will be held at the Society's rooms on Wednesday, May 14, at 8.30 P.M.

DR. J. BRONTË GATENBY, professor of zoology and comparative anatomy in Trinity College, Dublin, has been appointed Theresa Seessel Fellow of Yale University and will work there at experimental cytology from Sept. 25 next until April 9, 1931.

THE Lord President of the Council has appointed Sir Ernest Rutherford, president of the Royal Society, to be chairman of the Advisory Council of the Department of Scientific and Industrial Research in succession to Sir William McCormick as from Oct. 1 next. Prof. V. H. Blackman will serve as chairman until October.

SIR JOHN FARMER, formerly professor of botany in the Imperial College of Science and Technology, London, and Prof. Edmund Beecher Wilson, Da Costa professor of zoology in Columbia University, New York, have been elected honorary fellows of the Royal Microscopical Society.

THE twentieth meeting of the Australasian Association for the Advancement of Science will be held in Brisbane during the week commencing May 28, under the presidency of Mr. E. C. Andrews, Government Geologist, Sydney. The local honorary secretary for the meeting is Dr. D. A. Herbert, the University, Brisbane.

THE Linnean Gold Medal for 1930 of the Linnean Society of London has been awarded to Prof. J. P. Hill, professor of embryology, University College, London, and the Trail Award and Medal has been awarded to Dr. Kathleen Bever Blackburn, of the Botanical Department, Armstrong College, Newcastle-on-Tyne. The presentations will be made at the anniversary meeting to be held on May 24.

"NATIONAL Baby Week" is to be celebrated in Great Britain this year on July 1-7, and the National Baby Week Council (117 Piccadilly, W.1) suggests that at conferences special attention should be given to (*a*) the need for a national maternity service scheme, (*b*) better provision of nursery schools, and (*c*) spread of knowledge of parentcraft.

The thirty fifth general meeting of the German Bunsen Society (Deutsche Bunsen Gesellschaft) for experimental physical chemistry, the leading German society in this field, will be held at Heidelberg, for many years the scene of Bunsen's work, on May 28–June 1 The principal subject for discussion will be spectroscopy and formation of molecules The names of those desirous of participating should be sent to the "Ortsausschuss der Deutschen Bunsen Gesellschaft, Heidelberg, Ploeck 55", with particulars of any accommodation required

Owing to the prevalence of psittacosis or parrot fever in England and Wales during the last two months, the Minister of Health has issued an Order prohibiting as from May 20 the importation of parrots into the country (Statutory Rules and Orders, 1930, No 299, Covering Circular 1108 London H M Stationery Office) 'Parrot' includes macaws, cockatoos, love birds, lories, and others The prohibition does not apply, under safeguards, to birds required for research, or consigned to the Zoological Society of London

Curtis's Botanical Magazine, the beginning of periodical illustrated botanical literature, first appeared in 1787, and has an unbroken record of continuity Beginning in 1827, each volume has been dedicated to an eminent botanist or horticulturist, and the Royal Horticultural Society, which now owns the magazine, is arranging to publish a commemorative volume with a short life history of these persons, with their portraits Of the portraits required, only seven now remain to be obtained, namely Rev John Clowes (1777–1846), Capt Sir James Everard Home (1798–1853), George Curling Joad (died 1881), John Parkinson (died 1847), Sir Law(u)rence Peel (1799–1844), Mrs Sherbourne, and Mrs Wray Any information regarding these portraits should be addressed to the Secretary, Royal Horticultural Society, Vincent Square, S W 1

Farmers' and farm workers' associations and clubs, chambers of agriculture and horticulture, students' societies and other bodies interested in agriculture or market gardening, are invited to inspect the Rothamsted and Woburn Experimental Plots during the coming summer under the guidance of Mr H V Garner and Capt E H Gregory At Rothamsted the soil is heavy, and the experiments deal with the manuring of arable crops, especially sugar beet, potatoes, mangolds, fodder mixtures, barley, oats, wheat, and meadow hay At Woburn the soil is light, and the experiments there are concerned more particularly with the manuring of potatoes, sugar beet, malting barley, wheat, and the use of green manures All communications and requests to visit the Stations should be addressed to the Secretary, Rothamsted Experimental Stations, Harpenden

The Ministry of Health has issued a 'scheme' providing for the payment of contributions by county and county borough councils to voluntary associations which provide services for the welfare of blind persons, an explanatory circular (No 1086) accompanies it The scheme has been made under Section 102 (1) of the Local Government Act, 1929, and came into force on April 1 last Without such assistance the lot of the blind would be a pitiable one An article in the January–March issue of *The World's Health* (vol 11, No 1) points out that a large proportion of blindness is preventable and that an International Association for the Prevention of Blindness has been created, supported by twenty-eight countries, the League of Nations, the League of Red Cross Societies, and others

The Statistical Report of the Health of the Navy for the Year 1928 has been recently issued (London H M Stationery Office, 5*s* net) The returns for the total force, 90,820 strong, for 1928 show decreases in the incidence of disease as compared with the five years' average and with 1927 The total number of cases of disease and injury was 40,505, equal to a ratio of 445 99 per 1000, a decrease of 26 64 in comparison with the five years' average and of 33 06 in relation to 1927 The strictest attention is paid, especially in foreign waters, to sterilisation of water and milk, as well as to the control of dangerous articles of diet, with the result that only seven cases of typhoid and paratyphoid fevers occurred Venereal diseases, though showing some decrease compared with the five years' average, number 6175 cases, a slight increase relative to 1927 Malaria, with 469 cases, also shows a slight increase

A biography of Erasmus Darwin, author of "Zoonomia" (1794 96) and grandfather of Charles Darwin, has been written by Mr Hesketh Pearson and will be published shortly by Messrs J M Dent and Sons, Ltd Mr Pearson is a direct descendant of Darwin, and had access to his commonplace book and letters, as well as to family documents and other unpublished material

Applications are invited for the following appointments, on or before the dates mentioned —An assistant lecturer in engineering at the Cardiff Technical College—The Principal, Technical College, Cardiff (May 17) A lecturer in mathematics and a foundry instructor at the Constantine Technical College, Middlesbrough—The Director of Education, Education Offices, Middlesbrough (May 19) A junior engineer under the Safety in Mines Research Board, for research on colliery wire ropes—The Under Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S W 1 (May 19) An assistant engineer and lecturer in the School of Civil Engineering of the Gordon Memorial College, Khartoum — The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S W 1 (May 20) An assistant lecturer in mathematics at the Belfast Municipal College of Technology —The Principal, Municipal College of Technology, Belfast (May 20) Lecturers in mathematics and metallurgy at the Sir John Cass Technical Institute—The Principal, Sir John Cass Technical Institute, Jewry Street, E C 3 (May 22) An assistant lecturer in metallurgy at the County Technical College, Wednesbury—The Director of Education, County

Education Offices, Stafford (May 24) Evening teachers for building construction, carpentry, and joinery at the Richmond Technical Institute—The Education Secretary, Hotham House, Heron Court, Richmond, Surrey (May 24) An engineering assistant in the City of Nottingham Water Department—The Town Clerk, Guildhall, Nottingham (May 26) An assistant lecturer in the department of zoology and geology of University College, Southampton—The Registrar, University College, Southampton (May 26) An assistant lecturer in the department of metallurgy of the University College of Swansea—The Registrar, University College, Swansea (May 28) An assistant lecturer in political science at the London School of Economics and Political Science—The Secretary, London School of Economics, Houghton Street, Aldwych, W C 2 (May 29) A professor of zoology in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W C 2 (Aug 31) A lecturer in mathematics at the Diocesan Training College, Ripon—Miss Eva Lett, 14 Ladbroke Square, W 11 A civil engineering draughtsman under the South Staffordshire Waterworks Company — The Engineer in Chief, 26A Paradise Street, Birmingham Temporary assistant chemists in the Admiralty Chemist's Department, Portsmouth—The Admiralty Chemist H M Dockyard, Portsmouth

Our Astronomical Column

New Comet, 1930 d—A new comet of the tenth magnitude was found by Prof Schwassmann and Dr Wachmann at Bergedorf early on May 2, it is the fourth comet that they have jointly discovered, it makes the fifth observed comet to pass perihelion in 1930 The following positions for 1930 0 have been telegraphed by the I A U Bureau, Copenhagen

Date	R A	N Decl	Observers	Place
d h m	h m	° ′ ″		
May 2 0 38 2 U T	16 1 40	35 57	Schwassmann and Wachmann	Bergedorf
2 22 0 5	16 3 50 13	36 6 20	Struve	Neubabelsberg
3 21 39 3	16 6 46 00	36 17 35	Vinterhausen and Möller	Copenhagen

The roughly estimated position for the evening of May 10 is R A 16^h 28^m, N Decl 37° 42′, about 2¾° S W of η Herculis

The Total Solar Eclipse of April 28 in California—Extensive preparations were made by the Californian astronomers to utilise the brief totality of this eclipse to the utmost The eclipse afforded especial opportunity for observations of the flash spectrum, it was also hoped to obtain some photographs of the inner corona Observers in aeroplanes were to try to photograph the moon's shadow on the ground No astronomical reports are yet to hand, but from the telegrams in the daily papers it appears that the weather was clear It will be remembered that the predecessor of this eclipse in 1912 was just total in Portugal, and narrowly annular near Paris In 1858 it was almost total in England

The Lowell Planet—The Flagstaff orbit for this planet, with eccentricity 9/10 and period 3200 years, is still very uncertain Prof Banachiewicz and Dr C Smiley have calculated parabolic orbits on the hypotheses (1) that the motion is inward, which gives perihelion in 1958, (2) that it is outward, which gives perihelion in August 1902 Ephemerides on the two hypotheses are given in A U I Circ No 274 for the last three years Even in November 1927 the two orbits give positions differing by 8′ only, so that a longer arc than that of two months is required for a trustworthy result The node is now known to be within 1′ of 109° 22′, the inclination is within half a degree of 17° 10′, it is noteworthy that these two elements were predicted nearly correctly by Prof W H Pickering in his 1919 forecast, which also gave the present longitude correct within 5° He gave node 100°, inclination 15°, with estimated uncertainty 5° in each The present distance from the sun does not differ from 41 by more than a unit, but it is doubtful whether it is increasing or diminishing, increase is more probable Several orbits are given by E C Bower and F L Whipple in *Lick Bulletin*, No 421, four ellipses are given with periods 229 yr, 390 yr, 264 yr, 264 yr, also two parabolic orbits Prof W H Pickering states in a letter that he has found a period of 210 yr Unless images should be found on old plates, no decision on the eccentricity or period is possible until a longer arc is available

Harvard Announcement Card No 123 states that Mr Henroteau and Miss Burland have discovered an object on plates taken at Ottawa in 1924 that appears to be trans Neptunian, it cannot be the Lowell object, being too far north, the following positions are given, referred to the equinox of 1875 0

1924 Feb 7 666 G M T	R A 6^h 36^m 55^s	N Decl	23° 42 4
24 556	Position not given		
29 560	6 35 40		23 30 3

The magnitude is not given

From these figures Dr A C D Crommelin derives the following circular elements referred to equinox of 1924 Distance, 39 82, period, 251 3 years, node, 280° 29 4′, inclination, 49° 7′ In the Lowell planet the circular hypothesis gave a good approximation to the distance, so it may do so here also

New Constellation Boundaries—At the Leyden meeting of the International Astronomical Union in 1928, Commission III was requested to prepare maps of the constellations simplifying the constellation boundaries M E Delporte, with a committee to assist him, undertook this task, and the resulting star atlas has just been published by the Cambridge University Press The rule has been followed that the boundaries should be formed by lines parallel or perpendicular to the equator of 1875 The objection was raised at Leyden that the constellations have already lasted for thousands of years, and may last for a long time in the future, in which case the boundaries will become much inclined to the equator The ecliptic would have been a more stable direction However, on the basis that was adopted the work has been very well done, and the maps giving the new boundaries show also the stars down to magnitude 6 inclusive The boundaries have been laid down on the principle that variable stars should be kept in the same constellations as before, and that there should be as little disturbance as possible of stars that bear constellation letters or numbers The boundary between Pisces and Aquarius is so laid down that it will be about 6½ centuries before the equinox enters the latter constellation

Research Items

The Nisenan.—Mr. A. L. Kroeber publishes in vol. 24, No. 4, of the *University of California Publications in Archæology and Ethnology*, a study of a section of the Nisenan or Southern Maidu. Those with whom he deals are the valley people, who differ from those of the hills, though the two groups are sometimes classed together, on the ground of their unity of speech. In fact, Nisenan is not a specific tribal name, but is used in default of a native ethnic name. The Nisenan, now practically extinct, lived near Sacramento on the American and Feather Rivers. From the geographical and topographical information obtained, it was clear that native communications prevailingly followed the large streams, and therefore the ethnic outlook was directed towards the north and north-west within the Great Valley. The San Joaquin portion of the Valley was foreign. It seems that the groups tended to segregate themselves according to physiographic areas. Their dwellings were earth-covered, but at the mouth of Feather River they were tule-covered. They used as boats balsas made of tule and an approach to the canoe in the form of a log raft. Clothing comprised bark or tule aprons and duck feather blankets for the women, round shawls of tule for the men, and occasionally moccasins of buckskin. Their weapons were the bow with arrow points of obsidian, a spear of willow, used only in war, and a sling. The chief was selected when he was young, and succession was usually from father to son. Marriage within the village was not forbidden. Those who died of disease were cremated; but those killed in war were buried, as were also small children. A bear skin and ornaments were put on a dead person so that he should not trouble his living kin. The Kuksu cult or religious organisation comprised two societies with separate initiations. One was confined to men, the other took in a limited number of men and women. The dances were held in the summer in the dance house. The members of the *te'me'ya* ceremony or society wore a white ornament in the septum of the nose, which was bored for the purpose.

Acquired Characters.—The possibility that acquired characters may be inherited pushes itself more and more into the foreground, and Dr. M. F. Guyer's address to the Section of Zoological Sciences at the American Association for the Advancement of Science, on the last day of 1929, was a plea for further consideration of a theory which, twenty years ago, was regarded as discredited (*Science*, p. 169, Feb. 1930). He reviews some of the results of recent genetic studies by Muller, Metcalf, Goldschmidt, and others, and is led to ask whether the gene itself, or that larger vital unit of which it is a part, is really the fixed unvarying thing it is tacitly regarded to be. Genes must be nourished like other living things, since they multiply and grow and apparently display the other characteristics of living matter. They must therefore be open to the vicissitudes which beset other living substance. Once it is conceded that the constitution of the gene may wax and wane, then the way is open to the conception of how this may be induced through nutritive, toxic, or functional means. An acquired character might become an inherited character by some sort of germinal fixation that establishes it as part of the more habitual expression of the germ-plasm. The plasticity of the organism, to which these adaptations are attributed, must itself have genic significance, for the fact remains that the organism has the inherent capacity for acquiring the somatic modification.

Adelginæ (Phylloxeridæ) of North America.—In the *Stanford University Publications*, Biological Sciences, vol. 6, No. 1, Dr. P. N. Annand has a useful contribution towards a monograph of the American species of the group formerly known as the Chermesinæ and now, owing to changes of synonymy, termed the Adelginæ. In this work he describes and figures all the known American species, and gives a useful review of our knowledge of the biology of this exceedingly difficult subfamily of the aphides. Few groups of insects have so complex a life-cycle, or so great a range of polymorphism as is exhibited by the Adelginæ, while their importance, as pests of Conifers, renders it necessary that their economy should be adequately understood. Their primary host, so far as is known, is the spruce, while the intermediate hosts include such genera as *Larix*, *Pinus*, *Abies*, *Pseudotsuga*, or *Tsuga*, as the case may be. Some species, however, are confined to the primary host, and others to the intermediate host without migration between the two. For the most part, however, migration takes place and this fact has an important bearing upon control measures. What is known of the life cycle of these insects is due to the labours of a number of European investigators of several nationalities. A general summary of their work is provided and the terminology of Marchal is adopted in the systematic accounts of the American species. The latter form the greater part of the memoir and are drawn up with evident care and exactness. Dr. Annand's work brings together the essentials of what is known concerning these insects and should provide a stimulus to a better knowledge of the American species.

Buttress Roots.—Mr. T. Petch has an interesting note on this characteristic occurrence in the tropical forest in the *Annals of the Royal Botanic Gardens*, Peradeniya, vol. 11, part 3, January 1930; this is illustrated by some excellent photographs, which are, however, incompletely labelled for identification, whilst a text figure referred to in the paper frequently seems to be missing entirely. Buttress roots have usually been explained along teleological lines as supports to massive crowns, or as determined in position by prevalent winds. Mr. Petch's examination of their distribution does not confirm these theories, nor does he find them confined to the trees of the tropical rain forest. He points out the value, for observations and experiments upon this problem, of a tree like *Poinciana regia*, which shows wide differences as to the occurrence and distribution of such buttresses. He points out that in this species they may be found in young trees two to three years old, growing in quite sheltered positions; incidentally, he notes their occurrence in a seedling from a parent tree which was quite free from buttresses. He suggests as a working hypothesis that the presence of buttress roots is associated with a deficient tap root and that their formation is due to the restriction of the food and water currents to limited narrow regions of the stem continuous with the lateral roots. Mr. Petch also describes very interesting plank buttresses where the lateral stems join the main trunk, well above the ground, in some trees of *Canarium commune*; this occurrence, less commonly noted than the typical buttress roots, is illustrated by a very striking photograph.

Wankie Coalfield and its Fossil Flora.—*Bulletin* No. 15 of the Geological Survey of Southern Rhodesia is of particular interest in view of the discussion now

proceeding as to the age of the late Palæozoic glaciation of Gondwanaland Mr B Lightfoot describes the geology of the central part of the Wankie Coal field The Karroo succession ranges from the Lower Wankie sandstones to the Batoka basalts, the former resting on a floor of Archæan gneisses No intervening representative of the Dwyka conglomerate has been found in any of the exposures, but as this horizon elsewhere is older than the Wankie sandstones, the age of the latter is of critical importance Dr J Walton has already announced in NATURE (Oct 19, 1929, p 614) the significant discovery in the Upper Wankie sandstones of several species and genera of plants which are characteristic of the European type of Upper Palæozoic flora No such assemblage has hitherto been found in association with *Glossopteris* Dr Walton describes this mixed flora in a beautifully illustrated contribution to the *Bulletin*, and concludes that the evidence favours a Lower Permian or greater age for the Upper Wankie sandstones The South African glaciation is therefore early Lower Permian or late Carboniferous

French Floods of 1930 —The disastrous floods in the Midi of France early in March this year are described by M L Fournier in an illustrated article in *La Nature* for April 1 It is clear that the amount of rainfall, though heavy, was not alone responsible Thus at Clermont Ferrand the falls in January and February were 40 mm and 30 mm compared with the mean average of 35 mm and 32 mm At Nîmes the figures for the two months were 167 mm and 108 mm against a normal fall of 47 mm and 45 mm At Montpellier and Perpignan the excess was comparably as great But this excess of rainfall would not alone have caused floods of such magnitude had it not melted considerable winter snowfall and so enormously increased the deluge of water Furthermore, the rivers flowing to the west, the Aveyron and the Tarn, with their tributaries, flow in deep ravines which of course prevent the flood waters spreading and increase their disastrous effect The deforestation of the Cevennes and adjoining regions had much to do with the violence of the floods, in allowing the water to sweep over the surface instead of soaking into the soil held in place by matted roots Much of the destruction of buildings and bridges was certainly due to tree trunks swept against them, but these were isolated trees that were of no help in diverting the quick drainage of the hill sides

Electron Diffraction Rings —Some remarkably fine photographs of electron diffraction rings have been published by H Mark and R Wierl in the *Zeitschrift fur Physik* for Mar 18 They were obtained by passing electrons with velocities equivalent to between 30 and 50 kilovolts through sheets of aluminium, silver and gold about 10^{-6} cm in thickness, and are mostly analogous to the rings obtained in the powder method of X ray analysis The extreme sharpness of the rings is largely due to the fact that the time of exposure of the recording film has now been reduced to a fraction of a second, during which there is little chance for conditions to change within the apparatus The importance of this work lies partly in the information that it gives concerning the law of scattering of electrons by atoms, and partly in the fact that it is a step in the development of a new technique for the examination of thin films

Flow of Underground Water —In a paper entitled the "Exponential Law of Subsoil Flow", read by Dr N K Bose before the Punjab Engineering Congress, 1930, an interesting light is thrown on the difficult subject of the flow of underground water From observations upon a series of wells, from one of which water was pumped, Dr Bose shows that the ratio of any increments in the rise of the water level varies as the times of these rises, thus

if S_0 = the depression below rest level at time t_0
S_1 = " " " " t_1

$$\log_{10}\frac{S_0}{S_1} = -\lambda(t_1 - t_0)$$

The observations on several wells were carried out during a period of 8 days and appeared to confirm this relationship It is analogous to Slichter's relationship where, in the above, λ is a function of the yield and dimensions of the well Rewriting the above in the form

$$S_1 = S_0 e^{\lambda(t_1 - t_0)}$$

the author proceeds to correlate this exponential relationship with the similar laws of velocity flow (Stockes's equation) of viscous fluids

Anode Spots —In addition to the well known striations of the electric discharge in gases, another periodic structure occasionally appears in the form of a highly symmetrical arrangement of bright spots on the anode One investigation of the conditions under which these appear was reported by O S Duffendach and C H Thomas in the first January number of the *Physical Review*, and a second paper on the same subject has been published recently by J Oishi and K Yosiaka in the *Proceedings of the Physico Mathematical Society of Japan* (vol 12, No 1, January 1930) Cases have been recorded in which upward of seventy spots have formed on an anode a few square centimetres in area Occasionally the rings of spots rotate, presumably under the action of the magnetic field of the current passing through the discharge tube, but neighbouring rings of spots may move in opposite senses Spots have been found in hydrogen, carbon monoxide, nitrogen, and some other gases, but not in pure oxygen, argon, or neon The explanation of the origin of the spots is as yet incomplete, Prof Duffendach and Mr Thomas have adduced considerable evidence which tends to show that they are formed by gas being evolved from the material of the anode, and have made on this basis a study of some of the processes of evolution and absorption of gas in the discharge The Japanese investigators, however, from their work with hydrogen, question if this view is correct The regular array of spots is strongly reminiscent of a diffraction pattern

A New Lateral Extensometer —Few subjects, if any, have received more experimental attention from engineers than the measurement of Young's modulus, *E*, over a very wide range of conditions, and many extensometers such as those of Ewing and Marten are in common use On the other hand, apparatus for determining Poisson's ratio, η, are relatively few Among those who have devised such instruments is Prof E G Coker, who in *Engineering* for April 11 describes a new form of the lateral extensometer designed some years ago by Dr Scoble and himself An essential feature of such delicate instruments for measuring small displacements is that the forces produced in it should be minute, and this is obtained by the chief control being exerted by a light spring In general the instrument consists of a horseshoe frame carrying between its jaws two pointed spindles, one of which is provided with a micrometer screw, while the other presses against the short arm of a bell crank lever, the longer arm of which is connected to a small mirror which can rotate through a small angle The movement of the mirror will be proportional to the contraction of the specimen The horseshoe frame is mounted on a compound slide rest which in turn is

pivoted to a block which can be moved up and down a vertical pillar fixed in the base of the mounting One illustration shows the extensometer in use on a rod under tension, the reflected spot of light from the mirror being recorded autographically on a vertical revolving cylinder

Oxidation of Benzene —An investigation of the kinetics of the oxidation of gaseous benzene is reported by C N Hinshelwood and R Fort in the April number of the *Proceedings of the Royal Society* It has been found that the reaction is predominately homogeneous A first stage which occurs without change in pressure is followed by further oxidation of the initial products by a mechanism not unlike that of the oxidation of ethylene and acetylene, probably first to glyoxal, formaldehyde, and formic acid, and finally to steam, carbon monoxide, and a little carbon dioxide It appears that the reaction is of the chain type, and from the greater sensitivity of the rate of reaction to benzene concentration than to oxygen concentration, that the chains are propagated more readily when the initial oxygenated product encounters another molecule of hydrocarbon than when it is oxidised further by oxygen

Vapour Pressure of Solutions —A modified form of wet-bulb hygrometer suitable for the measurement of vapour pressures has been described by Prof A V Hill in the April number of the *Proceedings of the Royal Society* A symmetrically constructed thermo pile is set up in a test tube, in which the vapour pressure is maintained practically constant by the presence of a suitable solution supported on filter paper Two other strips of filter paper are moistened with the two solutions to be compared, and are laid one on each face of the thermopile, when a difference in temperature is set up on account of the different rates of condensation which is proportional to the difference between the vapour pressures of the solutions on the two faces The constant of the instru ment is found by calibration with known solutions It takes rather more than half an hour to obtain a reading, and the error of a single observation is of the order of 1½ per cent of the difference read This method for measuring vapour pressures has the great advantage that it requires very small quantities of the solutions, whilst it has a wide range, it being possible to measure, on one hand the difference in vapour pressure between 0 1 *M* sodium chloride and 0 2 *M* cane sugar, or, on the other, the difference between 5 *M* sodium chloride and water, the latter difference being of the order of 500 times the former

Dielectric Constants of Water and Hydrogen Peroxide —Measurements of the dielectric constant of water at various temperatures, made by Cuthbertson and Maas, are given in the February number of the *Journal of the American Chemical Society* The tem perature range used was 0° 75° The results of previous observers are divergent, and little attention has been paid to the measurement of the temperature coefficient over a wide range The values at 0°, 15°, 25°, 50°, and 75° C were found to be 84 4, 78 5, 75 4, 69, and 62 9, respectively From 25° to 75° the rela tion to temperature is approximately linear, at lower temperatures the numerical value of the coefficient is greater The authors point out that the value at room temperature, 18°, namely 77 0, is appreciably lower than the mean of the values found by other observers, namely, 81 05, whilst their values for non conducting liquids found with the same apparatus agree well with the accepted values They also note that the Debye equation for polarisability has no significance for a liquid such as water, in which the tendency to association probably varies with the temperature A second paper by the same authors deals with hydrogen peroxide, the dielectric constants of which and its aqueous solutions were measured A maximum occurs at 35 per cent of hydrogen peroxide The value for pure hydrogen peroxide is 89 2 at 0° The specific conductivity was less than 2×10^{-6}, indicating only very slight dissociation

Active Nitrogen — The March number of the *Journal of the Chemical Society* contains a further paper by E J B Willey on active nitrogen, in which the decay of the afterglow has been especially studied Previous work indicated that the ternary reaction $2N + N_2 = 2N_2$ + glow would provide an explanation of the negative temperature coefficient of the decay, but further work showed that the process was to be represented as $2N + 2N_2 = 3N_2$ and that the luminosity and chemical activity are closely related, and not independent as formerly suggested Other workers have found that the spectrum of the afterglow is independent of the nature of the impurities which must be present to cause nitrogen to develop its glow when sparked, and the view has gained ground that these 'photogens', as they are called, poison the walls of the vessel and prevent recombination of atoms thereon If this theory is correct, a quantita tive relation will exist between the decay mechanism and the purity of the nitrogen, and this was investi gated experimentally, the glow being measured by means of a photo cell The afterglow was found to be probably partly homogeneous and partly hetero geneous, according to experimental conditions Unless the walls of the vessel are poisoned by foreign gases, the recombination process is non luminous and occurs as a surface reaction As the concentration of impurity rises, the wall reaction diminishes and the homogeneous decay increases The afterglow probably originates in a reaction $N + N^1 = N_2^1$, $N_2^1 + N_2 = 2N_2$(+ afterglow), N^1 being a metastable 2 3 volt atom which is the chemically active species the energy of which has been measured earlier No changes are to be seen in the order of decay as it proceeds, neither do the spectral characteristics of the glow between 5900 A and 4000 A appear to alter

New Developments in Technical Electrolytic Processes —A lecture given by Prof Billiter to the Society of Austrian Chemists forms the subject of a lengthy article in the *Chemiker Zeitung* for Mar 12 Tribute is paid to the excellent work which has been done in this field by Americans Whereas it was generally supposed twenty years ago that electrolytic methods would gradually be replaced by thermo electric pro cesses, it is now realised that electrolysis is destined to play a leading part in technical operations in the future Amongst the processes which are carried out in aqueous solutions the following are described the refinement of copper, the extraction of zinc, the electrolysis of water, and the preparation of hydrogen peroxide The increased demand for pure water which is needed for electrolytic operations and for filling accumulator cells, has led to the development of methods of purifying water by electro osmosis, which yields a purer product than distillation Im portant progress has also been made in the use of molten electrolytes, particularly fluorides, by means of which the technical production of beryllium has become possible and improvements have also been made in the extraction of sodium and aluminium Sodium can now be obtained from the molten chloride, and aluminium is refined by the electrolysis of molten fluoride to a higher degree of purity than was possible in the older process The use of molten fluorides in electrolysis is rapidly becoming more common

The Future of British Agriculture

MANY people to day are searching for remedies for the depression that hangs so heavily over agriculture, particularly in Great Britain In a recent paper before the Surveyors' Institution, Mr T Wibberley makes his contribution to the problem, and envisages a future for British agriculture when it will rest, even more than to day, on livestock This will be achieved, in his opinion, not by the further extension of grassland, but rather by using arable land, to a much greater extent than at present, for the production of food for livestock, by the growth of forage crops, either for grazing, or for cutting for hay or silage, or for harvesting as mixed grain, and by keeping the land more continuously cropped

Livestock certainly holds out more promise than most other branches of farming Sir William Haldane has forecast a reasonably bright future for beef production at home, provided it be of good quality and that there are no great developments elsewhere, as yet unforeseen The stock population of Great Britain has lately decreased all round, and, if our beef has to face competition from chilled imports of high quality, our mutton is free from similar competition because of transport costs, our pork is at present protected by the import embargo, and there is abundant room for greater bacon production if we could but compete successfully with the Danish article In addition, we still have a sheltered market for milk, a market capable of considerable expansion by educating the public to the value of milk for children the poultry industry also is developing

As against this, grain can be produced so much more cheaply in other parts of the world that it can be transported for thousands of miles and still compete successfully with the home grown product It would appear unsound to base the future of our agriculture on the production of uneconomic crops At the same time, it is difficult to picture a farming system without grain, and even where it is uneconomical to sell, the farmer can feed more of his own grain to stock In successful farming systems in Great Britain or in Denmark at the present time, nearly half the arable area is still devoted to grain, indeed, Denmark recovered from the depression at the end of last century without appreciably altering the proportion of arable area devoted to grain Since the period 1889–93 this proportion has been consistently 2 or 3 per cent below that of England, but about 14 per cent greater than that of Scotland, where more use is made of temporary leys Grain crops are needed for the production of straw, required by the animals on the farm Arable land cannot yet be farmed successfully without farmyard manure, whether it be made naturally or by chemical means

The proportions of arable land devoted to different crops in the various periods from 1889 to 1927 is as follows

	1889–93			1899–1903			1909–13			1923–27		
	England	Scotland.	Denmark	England	Scotland	Denmark	England	Scotland	Denmark	England.	Scotland	Denmark
Corn crops	52	36	49	50	36	49	52	36	46	51	35	49
Roots	17	17	5	17	17	9	18	18	14	17	17	18
Green crops	27	46	39	30	47	36	27	46	35	28	48	31
Fallow	4		7	3		6	3		5	4		2

'Roots' includes potatoes
Green crops includes temporary grass, lucerne, mustard, etc.

Denmark emerged from her agricultural crisis by increasing the root break and the livestock population, although, even now, the proportion of arable area under roots is only slightly greater than in Great Britain, and much below what it is in particular districts, such as East Lothian and the Holland division of Lincolnshire Mr Wibberley suggests a similar change now for British agriculture, except that the increased production of stock food should be in the form of various forage crops rather than roots

There seems little doubt that forage crops are cheaper to produce than roots, and this economic problem reacts on the agricultural situation in a way that is frequently overlooked The labour situation, at least in the southern parts of Great Britain, is neither sound nor stable, and no farming system can be sound if it rests on an unsound foundation The farmer, under present conditions, cannot face a higher total wage bill, but it is equally impossible to retain the best men amongst the agricultural labourers at present wages, despite all efforts at rural education, particularly if and when an industrial revival occurs The future will probably see fewer workers, and, unless agriculture is content to struggle along with inferior labour, these will be more highly paid and will produce more, many aspiring, possibly, to eventual independence Labour considerations alone indicate developments of agriculture in three directions

(1) A more extensive mechanised farming, demanding, of course, large fields and open country
(2) More stock keeping, affording scope for good well paid men
(3) Smaller holdings worked by families setting a high value on independence, and recruited from the rising generation of keen young men, such as those sons of rural workers turned out in increasing numbers by farm institutes

Mr Wibberley is not hopeful of intensive grassland management However, if only the existing grassland in Great Britain were better managed, our stock carrying capacity would be greatly increased, but this would accentuate the problem of providing sufficient food to last the winter

The extent to which arable land should be further utilised for animal food production is difficult to decide Each district or even farm must be considered separately The weather is liable to upset a complex forage cropping system, soils in drier districts may dry out, weeds may get out of control, specially if the next crop is sown on the unploughed stubble of the old, particular farms—or farmers—may not be suited to tractor work, and certain soils would prove unsuitable for continuous cropping The crops grown would also differ in those parts where high yields are obtainable, and labour is efficient, roots can hold their own At very least, better advantage could be taken of the full growing season, and an end should be made of such practices as leaving a winter oat stubble untouched until the winter, and bare of crop from August to March or April

The future of British agriculture seems to demand a closer relationship between the grassland, well managed, and the arable, a better demand for the produce, particularly that raised under sheltered conditions, a better marketing organisation, more education, and the reduction of losses which may at present be preventible or non preventible One feels on safe ground in believing that the future of agriculture in any district will continue to be largely influenced by local conditions, economic, geographic, and climatic, and in accepting the Prime Minister's phrase, "the inevitability of gradualness" H G MILLER

The Physical Reality of 'Side-bands'

By F M COLEBROOK, Wireless Division, National Physical Laboratory

THE variation of the amplitude of a continuous electric wave in a periodic manner is commonly understood as being equivalent to adding waves of certain defined frequencies to the original wave train The mathematical formulation underlying this interpretation has not been questioned, but Sir Ambrose Fleming, an eminent authority on wireless communication, has recently voiced, in the columns of NATURE, a doubt that many others may have shared as to the physical reality of the added radio frequencies attributed to the process of modulation

It is necessary to consider what is meant by the words 'physical reality' in this connexion It will probably be generally agreed that no more than the purely pragmatic criterion is involved If an amplitude modulated continuous wave is found to behave in every respect as if it consisted of waves of the original frequency associated with waves of the hypothecated side frequencies, then the latter can be said to exist physically in the only sense in which the phrase has any useful meaning

From the purely practical point of view of wireless communication, the criterion can be still further limited to those characteristics which are actually involved in the processes of transmission and reception

Prof Fortescue [1] and Mr Ratcliffe [2] have pointed out in the course of correspondence on this subject that there is experimental evidence for the physical reality of side bands in the above sense The following experiments are thought to give clear and decisive evidence to the same effect

A valve maintained oscillator was adjusted to a frequency of 40,100 cycles per second In the field of this oscillator a receiving circuit was set up, consisting of an inductance and a tuning condenser A valve voltmeter was connected across the terminals of the latter, and the ordinary tuning curve of the receiving circuit was recorded It was found to be a single peaked resonance curve of the ordinary type The oscillator was then modulated at 4010 cycles per second by means of the e m f induced in a suitably tuned circuit coupled to an audio frequency oscillator set at the above frequency The tuning curve of the receiving circuit was again recorded It is shown in Fig 1 The tuning capacities of the side peaks correspond very approximately to the frequencies 40,100 +4010 and 40,100 -4010 cycles per second This demonstrates that the modulated continuous wave behaves as if it had wave components which produce resonance in a circuit tuned to the above sum and difference frequencies

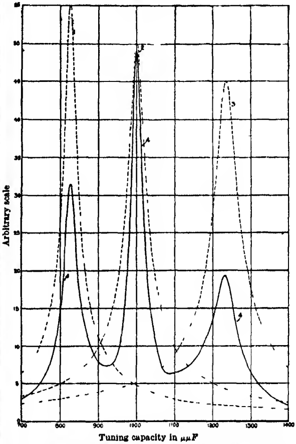

FIG 2—Curves 1, 2 3 calculated resonance curves corresponding to carrier and side frequencies assuming equal e m f s for each Curve 4 calculated variation of the modulation frequency output with tuning capacity Carrier frequency, 80,000 cycles/sec, modulation frequency, 8000 cycles/sec

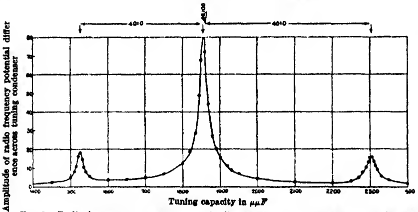

FIG 1—Radio frequency resonance curve Radio frequency, 40,100 cycles/sec, modulation frequency, 4010 cycles/sec

The next step was to investigate analytically and experimentally the result of rectifying the potential difference across the tuning condenser produced by the modulated field It is well known that the rectified current will contain a component of modulation frequency The case was analysed in general terms for square law rectification and a formula was derived expressing the variation of the intensity of the modulation frequency component as a function of the tuning capacity As a numerical example the following values were assumed

$\lambda = 3768$ metres
($\omega = 2\pi \times$ frequency $= 5{\cdot}1 \times 10^{5}$),
Modulation frequency = 7960
(i e $2\pi \times$ mod freq $= 5 \times 10^{4}$),
Receiving circuit inductance = 4 millihenries,
Receiving circuit resistance = 40 ohms

This case is illustrated in Fig 2 It will be ob-

served that there are three distinct tuning maxima corresponding very approximately (though not quite exactly) to the tuning capacities for resonance of the sum and difference frequencies Further, of the two side maxima, that corresponding to the smaller tuning capacity is taller and narrower than the other An important point is that the shape of this curve is independent of the modulation depth (that is, the relative magnitude of the amplitude change due to the modulation) The ordinates, however, are pro portional to the modulation depth

For the experimental investigation a rectifying valve was connected across the tuning condenser, and the in tensity of the modulation fre quency component of the anode circuit current was measured by means of the same valve voltmeter as was used in the radio frequency experiment Care was taken that the received voltage ap plied to the rectifier was small enough to result in square law rectification, and also that the recorded output voltage con tained no appreciable radio frequency components (these being filtered out by the action of an audio frequency trans former) The result is shown in Fig 3 The circuit constants and frequencies were different from those considered in the analytical case, and the re spective curves are not there fore in quantitative agree ment The principal features of the analytical de ductions are, however, fully confirmed, there being three distinct tuning maxima with similar relative heights and breadths (It will be noted that the radio frequency differs slightly—½ per cent, in fact—from that in Fig 1, but this is immaterial In each case the audio frequency was set to exactly one tenth of the radio frequency, to avoid interference between the latter and the tenth harmonic of the former)

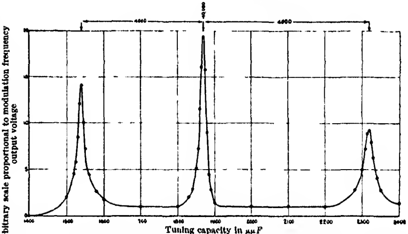

FIG 3 —Square law rectification of modulated continuous wave Radio frequency 40,000 cycles/sec , modulation frequency, 4000 cycles/sec

The above analysis was based on the usual repre sentation of the modulated wave as the sum of a carrier frequency and the two sum and difference frequency wave trains The experimental confirma tion, therefore, shows that these side frequencies exist physically in an actual modulated wave train in the sense in which that phrase has been defined above

It should be pointed out that if in another actual case the three peaks are not observed, it will not be a logical deduction that the side frequencies do not exist The matter is quite comparable with spectrum analysis in optics There is a limit to the resolving power obtainable with a spectroscope or grating Similarly there is a limit to the resolving power ob tainable in a tuned receiving circuit For example, with carrier and modulation frequencies of a million and a hundred cycles per second respectively, there would almost certainly be one peak only in the tuning curve, unless by some means, such as the use of retro action in the valve rectifier, the receiving circuit resistance were reduced to very much less than its normal value Thus the separate peaks may not be observable under medium wave broadcasting condi tions It was found, however, that three peaks were observable in another set of measurements made at frequencies comparable with those involved in long wave broadcasting

Full details of the theoretical and experimental work described above are given in a paper entitled "The Rectification of a Modulated Continuous Wave" which will shortly be published in *Experi mental Wireless*

[1] NATURE Feb 8 1930
[2] NATURE, Feb 22 1930

Kevin-Sunburst Oilfield, Montana

MUCH is heard concerning the oil possibilities of the Rocky Mountain States of North America, but in spite of all the survey work accomplished in likely regions, there has really only been one con spicuous development, Salt Creek, Wyoming, a field which is still producing well over 20,000 barrels of oil per day It is therefore encouraging to note the progress of the comparatively new Kevin Sunburst field in Montana, which, with a daily production of more than 6000 barrels and with reasonable prob abilities of extension, ranks second in importance throughout the mountain States

Oil was originally discovered at Kevin in March 1922 in a structure known as the Sweetgrass arch, an uplift comparable in many respects with the better known Cincinnati fold of Ohio The Kevin Sunburst structure is essentially a 'bulge' on the crest of the arch, located just south of the Canadian boundary In the five year period to 1927, some 1500 wells were drilled into this structure, of which more than 880 were productive, a proportion which, for the Rocky Mountain fields, is quite high The area has more than usual stratigraphical interest, since it includes a prominent representative of the Jurassic system beneath the thick spread of Cretaceous rocks so characteristic of this part of the world One does not expect extensive developments of Jurassic rocks in the Rocky Mountain States, having regard to geo logical conditions in general at this epoch, still more surprising is the fact that the best production of petroleum in this field comes from the Ellis formation of that age, from sands situated not far above the

base, an unconformable contact with the Carboniferous There is also minor production from the Cretaceous beds

The point at once arises that the Carboniferous rocks (Madison limestone) may be the ultimate source of the oil and that the Jurassic can only claim migrated supplies The unconformity is a big one, so that this may indeed be the case, though Mr A J Collier, the author of the recent bulletin on the subject (U S Geological Survey, No 812 B) giving the latest account of this field, inclines to the view that the indigenous source is the Ellis formation, and backs his opinion with data of more than local interest

University and Educational Intelligence

CAMBRIDGE —The Sheepshanks Exhibition for proficiency in astronomy has been awarded to R D H Jones, scholar of Gonville and Caius College

The Appointments Committee of the Faculty of Archæology and Anthropology has reappointed R U Sayce to be University lecturer in material culture and physical anthropology

Sir William Pope announces that Dr Ernest Fourneau, of the Pasteur Institute, Paris, will give a lecture on the Liversidge Foundation on Friday, May 9, at 5 P M , on " Chemo Therapy "

APPLICATIONS for grants from the Chemical Society Research Fund must reach the Assistant Secretary of the Society, Burlington House, W 1, not later than June 2 The requisite form is obtainable upon request

RAMSAY memorial fellowships for chemical research, one limited to candidates educated in Glasgow, will shortly be awarded The fellowships will each be of the yearly value of £250 plus, possibly, a grant for expenses They will be tenable for two years, with a possible extension of a year Applications must be sent to reach the secretary of the Ramsay Memorial Fellowship Trust, University College, Gower Street, W C 1, by June 5 at latest

STATE grants to Universities in Great Britain are to be increased by £250,000 a year For five years they have stood at £1,550,000, to which figure Sir Austen Chamberlain raised them in 1925 When the Universities presented to the Chancellor of the Exchequer last November, through a deputation introduced by Lord Cecil, the case for a further increase, they asked also for capital grants for buildings Mr Snowden recognised " the great and increasing extent to which they are serving the social and industrial progress of the people " and that " it is quite reasonable that the State should contribute in substantial measure to the cost of maintaining our universities and colleges as active centres of education and research, and few, if any, items of public expenditure can be of clearer national value ", but he holds that there is comparatively little weight in the arguments for capital grants The most cogent argument for increased assistance is based on the increased expensiveness, due to the progress of science, of the plant and staff requisite for maintaining the high standard of efficiency in instruction and research which is indispensable for national well being in the face of the economic competition of other nations in the world of commerce For the provision of new plant Mr Snowden thinks that " the fine record of benefactions received by the universities during the last four or five years encourages the hope that during the coming quinquennium private generosity may again prove not unequal to the task "

Historic Natural Events

May 11, 1894 Remarkable Hail —During a severe hailstorm at Vicksburg (U S A) a remarkably large hailstone was found to have a solid nucleus, consisting of a piece of alabaster, from ½ to ¾ inch in length During the same storm, at Bovina, 8 miles east of Vicksburg, a gopher turtle, 6 in by 8 in , and entirely encased in ice, fell with the hail These hailstorms occurred on the south side of a region of cold northerly winds , they were apparently accompanied by local whirls which carried heavy objects from the earth's surface up to the clouds, where they were encased by successive layers of snow and ice

May 12, 1811 Tornado in Derbyshire —About 5 P M at Bonsall, in the Peak district, a singular motion was observed in a cloud of serpentine form, which moved in a circular direction, from south by west to north, extending itself to the ground It began near Hopton, and continued along a course about five or six miles in length and about four or five hundred yards in breadth, tearing up plantations, levelling barns and miners' cots It uprooted large ash trees, carrying them 20 30 yards, and twisted the tops from the trunks of other trees, dropping them 50 100 yards away Cows were lifted from one field to another, and injured by the fall, miners' bubble tubs, wash vats, and other materials were carried to a considerable distance and forced into the ground The tornado was accompanied by a tremendous hailstorm , stones and lumps of ice fell which measured from nine inches to a foot in circumference, breaking windows and injuring cattle

May 13, 1922 Hailstorm at Montpellier, France -- On this date a hailstorm occurred at Montpellier, France So great was the fall that traffic was blocked in the streets, and the inhabitants were obliged to clear the pavements with shovels The hailstones averaged half an inch in diameter, and on open ground they lay to a depth of four inches, but in streets where they were washed into heaps by the accompanying rain, and caked together, they formed a layer from 1½ to 2 feet deep

May 13–17, 1921 Magnetic Storm and Sunspot — A magnetic storm of great intensity and long duration commenced on May 13 6 and lasted until May 17 At Greenwich the traces of declination, horizontal force, and vertical force passed continually beyond the recording sheets , the measured ranges of the three elements were respectively $>100'$, $>740\gamma$, and $>460\gamma$ At Kew the corresponding ranges were $132'$, $>650\gamma$, and 1500γ The storm reached its greatest intensity between 0^h and 8^h G M T on May 15 Oscillations of the needles were frequently so rapid that the movements were barely recorded on the photographic sheets The disturbance was accompanied by brilliant displays of the aurora, and there were serious dislocations of the telephone and telegraph services over a great part of the world At the time of the commencement of the storm, a large naked eye sunspot was one day's travel east of the sun's central meridian The spot, which was situated on the sun's equator, was of unusual development

May 14, 1886 Floods —Following three days of excessive rainfall in Wales and the west Midlands on May 11–13, disastrous floods occurred on May 14 and 15 At Worcester the Severn rose to 17 ft 10 in above the ordinary summer level , this was described as the highest flood for 115 years The Trent at Nottingham was nearly 19 feet above the summer level, but did not equal the flood of 1852

May 15, 1586 Waterspout —At Kestrzan in Bohemia a powerful whirlwind carried the water of two

ponds into the air with all the carp and pike that they contained On the following day there was a water spout on Lake Constance near Meilen

May 15, 1608 Cold Spring —Not only the winter of 1607–8 (see Jan 10) but also the following spring, were abnormally cold The rivers remained frozen well into the spring, and it is recorded that so late as May 15 boys were sliding on the frozen ditches at Dantzig The season was also severe in North America, and resulted in the destruction of the European colony of Sagadahoc

May 15, 1893 Drought —The famous 'spring drought' of 1893 was, while it lasted, one of the most severe on record in England and the neighbouring parts of Europe For a period of 114 days commencing on Feb 28, the total rainfall in London was only 1 09 in, and during the four months March to June less than a third of the normal rainfall was experienced in southern England At Hurst Castle (Hampshire) a period of 59 days from Mar 18 to May 15 was completely rainless, and a large part of southern England had no rain in April

May 16, 1646 Rain of Brimstone Worm relates that "the whole city of Hasnia [? Asmara Is off Italy] and all its streets were inundated with a mighty rain so that men were prevented from walking and the air was infested with a sulphureous odour, when the waters had subsided somewhat it was possible in some places to collect a sulphureous powder, some of which would pass for real sulphur as regards taste, colour, smell, etc"

Societies and Academies

LONDON

Geological Society, April 9 —**Léon W Collet** The structure of the Canadian Rockies The results of a two months' expedition (financed by the Shaller Fund) along the Athabasca Valley (Jasper National Park) and round Mount Robson (B C) A complete section across the Rockies was made, from the eastern border to Yellow Head Pass This mountain chain is made up of seven 'blocks' thrust one over the other from west to east, and separated by 'clean cut thrusts' of the type of the North West Highlands of Scotland The Canadian Rockies and the Alps show two different types of folding The structure in blocks of the Canadian Rockies corresponds to Argand's 'ground folds' (*plis de fond*), while the Alps are made up of 'recumbent folds' developed in a geosyncline In the Canadian Rockies the energy necessary for the folding was much greater than in the Alps for in the former the strata have been cut into blocks as far down as the Pre Cambrian The Ordovician and the Silurian are missing in the eastern part of the Rockies The Ordovician alone appears in the western part This stratigraphical gap is a repercussion, across the Canadian Shield, of the Caledonian folding of the Canadian Appalachians

Royal Meteorological Society, April 16 —**S K Banerji** The electric field of overhead thunderclouds Changes in the electric field produced by eighteen thunderclouds during their passage over the Colaba Observatory in 1929 suggest that the majority were of the 'unitary type' and had their front part negatively charged, the central part positively charged, and the rear negatively charged A few were of the 'double type' and produced changes in the field as if two thunderclouds of unitary type had passed over in succession In those thunderclouds which caused heavy rainfall, fluctuations in the central positive field occurred by loss of charge by rainfall or by increased concentration of positive charge by increased vertical current, in agreement with the breaking drop theory The monsoon clouds produced an electric field which was pre eminently negative during periods of rainfall —**F J W Whipple** The great Siberian meteor and the waves, seismic and aerial, which it produced On June 30, 1908 a great meteor fell in Siberia, probably the greatest meteor which has occurred in historic times The blast of air produced by the meteor devastated the forests over an enormous area Leonard Kulik explored the region in 1927 and found the numerous holes in which, it is presumed, the fragments of the original meteor are buried The impact of the meteorites caused seismic waves which were recorded at four observatories, the most distant of which was Jena Remarkable waves recorded by sensitive barographs in England were produced by the meteor The waves took five hours to travel from Siberia to England, the velocity being a little greater than that of the waves due to the famous eruption of Krakatoa

PARIS

Academy of Sciences, Mar 24 **Bigourdan** The instruments and observations of P J de Beauchamp Historical account of the astronomical instruments used at the end of the eighteenth century by Beauchamp at Bagdad and elsewhere —**A Cotton** and **M Scherer** The magnetic double refraction of specimens of petroleum from various sources Six specimens, with boiling points up to 250° C and roughly refined, were examined, the large Bellevue magnet being utilised for the observations The ratio $\frac{C_m}{d} \times 10^{14}$, where C_m was the double refraction for unit field and unit thickness, varied between 5 53 for Pechelbronn petroleum to 27 0 for the Moronic oil —**Henri Villat** and **Maurice Roy** The problem of Saint Venant in the case of pure torsion —**Alfred Rosenblatt** Certain relations between the integrals of the first species of Picard belonging to an algebraic surface **M Cioranescu** Certain inverse problems relating to potential —**Maurice Coissard** A class of partial differential equations of the first order, with two independent variables —**Antonio Signorini** A mixed problem —**T Bonnesen** Inequalities between arithmetical means —**J Dieudonné** Some applications of the lemma of Schwarz —**Henri Cartan** The analytical transformations of encircled domains —**L Ahlfors** Some properties of meromorph functions —**Elie Cartan** Linear representations of simple and semi simple groups —**R Swyngedauw** The measurement of the power dissipated in organs of transmission **N S Argeanicoff** The theory of Witoszinsky —**Alexandre Rajchman** An algebraic equation which occurs in the kinetic theory of gases —**Th De Donder** The signification and invariance of the quantic constant h deduced from gravifics —**Pierre Bricout** An absolute micromanometer with electrostatic compensation —**A Poirot** The anodic rays of sodium, potassium, calcium, and barium —**Constantin Salceanu** The magnetic double refraction of organic substances in the fused state The measurements were made with the large electro magnet of the Academy of Sciences in a field of about 43,000 gauss Data are given for β-methylnaphthalene, at temperatures between 89° C and 36 5° C, and for three different wave lengths —**R Coustal** and **F Prevet** The optimum concentration for the phosphorogen and flux in zinc sulphide, copper, and the variation of this optimum with the temperature of the preparation Copper behaves differently from other phosphorogens, especially as regards the extremely small quantities required when the temperature of preparation is high —**Guy Emschwiller** The photolysis of organic

iodides the utilisation of the light The photolysis of organic iodides is a complex phenomenon The coefficient of utilisation of the ultra violet light depends on the temperature and on the nature of the organic compound The quality of the radiation also has an effect In the calculations it is necessary to take into account the fact that the iodine set free acts as an internal screen Details of experiments on ethyl iodide are given —**Maurice François** The action of concentrated ammonia on the compound $HgCl_2 2NH_3$ The formation of monomercuriammonium chloride, $HgNH_2Cl$, and of hydrated dimercurammonium chloride, Hg_2NCl,H_2O —**J J Rutgers** The micro estimation of mercury in organic compounds The organic compound is burnt in a current of oxygen mixed with the vapour of aqua regia, the mercuric chloride formed being afterwards electrolysed Examples are given showing the accuracy of the method —**Edmond Rabaté** and **Jean Fleckinger** A colour reaction for the proteids of the wheat seed The hydrobromic acid reagent suggested by Denigès as a specific test for ionised copper is also a good reagent for the proteids of the embryo and the diastase layer of wheat seeds —**Albert Kirrmann** The condensation of pyruvic acid with the fatty aldehydes **Desmaroux** and **Mathieu** The solutions of diphenyl urea in nitrocellulose Study of the alterations produced in the X ray photographs of films of nitrocellulose by the additions of varying proportions of diphenylurea to the nitrocellulose solutions before forming the film —**M Bourguel** and **R Truchet** The action of the chlorides of the aromatic sulphonic acids on the sodium derivatives of acetylene hydrocarbons In an attempt to prepare acetylene sulphones the reaction was abnormal, there was no sodium chloride produced, the reaction found being

$$R\ C\equiv C\ Na + ClSO_2R' \rightarrow R\ C\equiv C\ Cl + R'SO_2Na,$$

a simple exchange of chlorine for sodium, the reaction products being a sulphinate and a chloro derivative of the acetylene hydrocarbon **L Berthois** Study of the heavy minerals of the granite massif of Fougères (Ille et Vilaine) Details of the isolation of zircon, tourmaline, monazite, sphene In the contact zone were found andalusite, sillimanite, and zoisite **Ch Gérard** Some particular points of the stratigraphy of the ferruginous Aalenian of Meurthe et Moselle —**André Rivière** A section observed in the middle valley of the Djerjeroud (Persia) —**H Arsandaux** The present eruption of Mt Pelée The products of consolidation do not differ from those of the previous eruption —**Mlle D Le Maitre** The presence of algæ and of foraminifera of the genus *Endothyra* in limestones of Devonian age —**A Demolon** and **G Barbier** The valuation of the phosphoric acid deficiency of soils The basis of the method is the amount of phosphoric acid extracted by the soil from a phosphate solution containing 1 per cent of acetic acid and varying proportions of phosphate It is considered that such measurements form a better criterion of the deficiency of the soil in phosphates than the determination of the amounts of phosphate extracted from the soil by the usual methods —**Emile F Terroine** and **Mlle Thérèse Reichert** Common salt in cattle feeding its action on nitrogenous metabolism —**A Vandel** The production of *intercastes* in the ant, *Pheidole pallidula*, under the action of parasites of the genus *Mermis*

GENEVA

Society of Physics and Natural History, Feb 20 —**P Chodat** A new method for the determination of the iso electric point by ferments The author communicates the results of his experiments relating to the variations of the curve expressing the activity of the ferment catalase as a function of the real acidity of the medium according to the nature of the system employed, saline or protein, normal or deviating curves are obtained Deviations are interpreted as being due to the isoelectric state of the particles of proteid utilised as a buffer —**R Wavre** The method of the cavity and the internal movements of the planets The author shows that the method of the cavity, for the discussion of the equilibrium figures relating to the fluid stars, is still applicable if the latter are endowed with permanent rotation of genus one The study of the internal movements of genus one, although longer, does not introduce essentially new theoretical difficulties compared with the study of equilibrium figures

ROME

Royal National Academy of the Lincei, Jan 5 —**T Levi-Civitá** Characteristics and bicharacteristics of Einstein's gravitational equations The general theory of characteristics developed by Volterra and Hadamard is applied to the particular case of the gravitational equations of relativity —**V Nobile** The intermediary trihedra of reference for stellar dynamics criteria of selection —**L Rolla** and **L Mazza** Systems of telegraphy and telephony by means of pencils of infra red radiations Experiments are described in which the source of the radiation is an arc between hollow carbons packed with mixtures of halides (mainly fluorides) and oxides of alkali and alkaline earth metals The modulation circuits were analogous to those used by other investigators, but were fitted with devices to render the arc more stable, while the modulation current was obtained by amplifying the microphone current by a thermionic valve The transmitter consisted of a small parabolic mirror (diameter 18 cm), of ray filters, and of a special electromagnetic vibrator connected with a Morse telegraphic transmission instrument With arcs carrying 100 watts, satisfactory telephonic communication was possible over distances exceeding 6 km —**G Tizzoni** and **G De Angelis** Certain causes which may weaken or destroy the immunising power of our phenolated anti cancer vaccine Infection of adeno carcinoma pus (Ehrlich), even with common bacteria, modifies appreciably and in some cases completely annuls the activity of the phenolated vaccine Such infection has no effect on the growth or power of the virulent cancerous pus which has thus greater resistance than the vaccine It is hence absolutely necessary that the vaccine should be bacteriologically pure —**E Bompiani** Projective interpretation of certain ordinary differential equations of the second order New results are given in connexion with the projective interpretation, already published, of certain types of differential equations $v'' = F(u, v, v')$ on a surface σ of S_3 —**L Laboccetta** Segmental interpolation and classification of polygonal functions —**C Popovici** Integro functional equations —**L Godeaux** A property of the envelope of certain families of quadrics —**B Finzi** Dynamic actions relative to plane irrotational motions of viscous liquids Formulæ are determined which permit of the characterisation of the dynamic actions exerted on a line of flux by a viscous liquid in irrotational motion The expressions obtained represent the sum of two terms, the first being independent of the viscosity of the liquid and expressible by the known formulæ of Blasius, while the second gives the effect due to the viscosity The expressions defining the viscosity are particularly simple and are analytical in character, moreover, they are valid not only for lines of flux but, unlike the expressions of the formulæ of Blasius, also for any line whatever —**N Siracusano** New phenomena observed in the annular discharge The two hypotheses,

advanced by J J Thomson and Lehmann respectively, to explain the annular discharge observed when the discharge currents of two large Leyden jars excited by a coil or an electric machine are passed through a few coils of copper wire round a highly evacuated glass tube or flask, are discussed The conclusion drawn is that both hypotheses may be accepted, since the conditions of excitation and gas pressure are such as to give rise to the causes assumed by each Various new observations are described —**Remo de Fazi** and **F Pirrone** Studies on indones, new reactions of α ethyl β phenylindone and of α methyl β phenylindone (10) Attempts to prepare diethyldiphenyltruxones by the action of copper on αβ dichloro α ethyl β phenylhydrindone, obtained by passing chlorine into a solution of α ethyl β phenylindone in anhydrous carbon tetrachloride, resulted in the formation of αα[1] diethyl ββ[1] dichloro ββ[1] diphenyldihydrindone and α ethyl b phenylindone —**E Oddone** The depth of activity of the hypocentres of earthquakes and the causes of the latter **M Tirelli** Irreversible change in the viscosity of the eggs of *Bombyx mori* L The experiments described deal with the changes produced in the viscosity of silkworm egg juice with eggs of a pure Chinese race and of a Chinese Italian cross by heating and by treatment with gaseous ammonia —**C Jucci** Pigments of the blood, cocoon and egg of the silkworm —**G Lentati** Study of the primary endocrine tissue of the pancreas of birds **G Mezzadroli** and **E Vareton** Further investigations on the action exerted by a radio oscillator for ultra short waves of 2 3 metres wave length on the germination of seeds and on the growth of plants (1) Ultra short electromagnetic waves always exert a favourable influence on the germination of seeds and on the development of plants, the extent of the action increasing with the nearness of the radio oscillator and, within certain limits, with the intensity of the waves Interposition of a Lakhovsky oscillating circuit over the germinator or plants during the exposure to the waves enhances the effects —**L De Caro** Regulating power of the principal constituents of muscle juice

Official Publications Received

BRITISH

The Proceedings and Transactions of the Nova Scotian Institute of Science Halifax Nova Scotia. Vol 17 Part 3, Session 1928 1929 Pp xix xxxii+149 212+iii (Halifax N S) 50 cents

Commonwealth of Australia Council for Scientific and Industrial Research Pamphlet No 17 The Mineral Content of Pastures Progress Report on Co operative Investigations at the Waite Agricultural Research Institute Pp 29 (Melbourne H J Green)

Government of India Meteorological Department. Magnetic Meteorological and Seismographic Observations made at the Government Observatories, Bombay and Alibag, in the Year 1925 under the direction of Dr S K Banerji Pp iv+135+5 plates (Calcutta Government of India Central Publication Branch)

Union of South Africa Department of Agriculture Science Bulletin No 74 South African Tanning Materials Part 2 Trees and Plants other than the Black Wattle By C O Williams (Division of Chemistry Series No 93) Pp 68 (Pretoria Government Printing Office) 6*d*

The Ross Institute and Hospital for Tropical Diseases (Incorporated) Putney Heath, London, S W 15 Annual Report and Accounts for 1929 Pp 65 (London)

Quarterly Journal of the Royal Meteorological Society Vol 56 No 234 April Pp 103 205 (London Edward Stanford, Ltd) 7*s* 6*d*

Journal of the Chemical Society April Pp iv+569 905+x (London)

Proceedings of the Cambridge Philosophical Society Vol 26 Part 2, April Pp 123 284 (Cambridge At the University Press) 7*s* 6*d* net

The Quarterly Journal of the Geological Society Vol 86 Part 1 No 341, April 23rd Pp xlviii+128+14 plates (London Longmans, Green and Co, Ltd) 7*s* 6*d*

FOREIGN

Mitteilungen der Prähistorischen Kommission der Akademie der Wissenschaften Band 2, Nr 5 Der Oberleiserberg ein Zentrum vor und frühgeschichtlicher Besiedlung Von Dr Herbert Mitscha Marheim und Dr Ernst Nischer Falkenhof Pp 391-488+19 Tafeln (Wien Hölder Pichler Tempsky A G)

Field Museum of Natural History Zoological Series, Vol 18 No 1 Descriptions of Five new Indo Chinese Birds By Outram Bangs and Josselyn Van Tyne (Publication 272) Pp. 4 (Chicago)

University of California Publications in American Archaeology and Ethnology Vol 28 No 3 The Ghost Dance of 1870 in South Central California By A H Gayton Pp 57 82 (Berkeley Calif University of California Press London Cambridge University Press) 35 cents

The Peking Society of Natural History Bulletin Vol 4 Part 3 Yenching Science Conference Papers Pp 117 (Peking) 1 50 dollars

Flora Sinensis Series B Vol 24 Part 1 Chinese Medicinal Plants Ephedra Part 2 The Botany of Mahuang By Prof Bernard E Read Abstracted from the work of J C Liu, with additional Notes from Stapf, Meyers Groff and others Pp 29+2 plates (Peping Peping Union Medical College)

Journal of the Faculty of Agriculture Hokkaido Imperial University Sapporo Japan Vol 26 Part 1 Flora of Hokkaido and Saghalien I Pteridophyta and Gymnospermae By Kingo Miyabe and Yushun Kudo Pp iii+79+3 plates (Tokyo Maruzen Co Ltd)

Scientific Papers of the Institute of Physical and Chemical Research Nos 228 231 Does Puncture Test under Oil give the True Electric Strength of Insulators? by Takeshi Nishi Contribution to the Study of Photographic Chemistry Report 1 On the Dispersion of Silver Halides through Aqueous Medium by Tsuneo Suzuki On the Spark Ignition of Low Inflammable Gas Mixtures by Kiyohiko Yumoto Colour of Alloys by Masawo Kuroda Pp 27 320+plates 20 23 95 sen No 232 The Near Infra Red Spectra of Helium and Mercury, Part 2 By Toshio Takamine and Taro Suga Pp 6+3 plates 25 sen No 233 On the Absorption Spectra of Salt Solutions 2 The Absorption Spectra due to the Oxyacidic Anions By Sechi Kato Pp 7 21 25 sen No 234 The Angular Intensity Distribution of Continuous X ray Spectrum 2 By Yoshikatsu Sugiura Pp 23 47 0 sen No 235 On the Absorption Spectra of Salt Solutions 3 The Absorption Spectra due to the Cations By Sechi Kato Pp 49 58 25 sen (Tokyo Iwanami Shoten

CATALOGUES

A General Catalogue of the Manufactures of Adam Hilger Ltd, containing Sections D E F H K L M, and N (January 1930) Pp 8+D29+E49+F44+H44+K3+L9+M30+N10+x (London Adam Hilger Ltd)

Classified List of Second hand Scientific Instruments (No 97 April 1930) Pp vi+58 (London C Baker)

Diary of Societies

FRIDAY, MAY 9

ROYAL SOCIETY OF ARTS (Indian Meeting) at 4 30 —Dr D Clouston The Report of the Royal Commission on Indian Agriculture

ROYAL ASTRONOMICAL SOCIETY at 5 —Dr J S Plaskett The High Temperature Stars (George Darwin Lecture) — Radcliffe Observatory Oxford Positions of the New Planet from Photographs taken at the Radcliffe Observatory

ROYAL COLLEGE OF SURGEONS OF ENGLAND at 5 —Sir Arthur Keith The Anatomy of Fossil Man The Races represented by Fossil Remains discovered by Miss Dorothy Garrod in the Caves of Palestine

PHYSICAL SOCIETY (at Imperial College of Science) at 5 —E J Williams (*a*) The Inductance of Electromotive Forces in a Moving Liquid by a Magnetic Field and their Application to the Investigation of the Flow of Liquids (*b*) The Motion of a Liquid in an Enclosed Space —E Simeon The Generation of Sound by the Siren Principle —Demonstration by Dr A G Milligan of the Regional Absorption of Dyes by Crystals of Alum and Rochelle Salt

ROYAL SOCIETY OF MEDICINE (Clinical Section) at 5 30 —Annual General Meeting

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society) at 6 —E R Sykes On a New Species of *Turris* from Japan —G C Robson Remarks on Melanism in Land Mollusca

INSTITUTION OF ELECTRICAL ENGINEERS (London Students Section) (Annual General Meeting) at 6 1 —J W Moffatt and J C Emerson The Rotary Automatic Telephone System

BEDSON CLUB (Armstrong College Newcastle upon Tyne) at 6 30 —Prof J B Cohen Synthetic Drugs (Bedson Lecture)

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (Annual General Meeting) (at Criterion Restaurant Piccadilly) at 6 45 —Sir Frederic L Nathan and others Discussion on The International Abstracting and Classifying of Scientific Literature —Dr H Levinstein Chemistry House—the Present Position —H J Pooley The Jubilee Meeting of the Society

ROYAL INSTITUTION OF GREAT BRITAIN at 9 — Prof J Garstang Archæology and Bible History

ROYAL SOCIETY OF MEDICINE, at 9 —Prof J Murdoch Radium Treatment of Cancer (Lecture)

SATURDAY MAY 10

PHYSIOLOGICAL SOCIETY (in Physiology Department Cambridge) at 2 30 —W H Forbes and F J W Roughton The Oxygen Dissociation Curve of Dilute Blood Solutions —N B Taylor H D Branion, and H D Kay Some Effects of the Administration of Excessive Doses of Irradiated Ergosterol to Normal and Parathyroidectomised Dogs —H J Jordan The Viscosity of Muscles in Lower Organisms its Biological Significance and its Regulation by Nervous Centres —Dr G V Anrep Respiratory Arhythmia —G Stella Coronary and Thebesian Circulation —E Volhard Carotid Sinus —Prof J Barcroft Some Effects of Trauma on the Volume of the Spleen —T Cunliffe Barnes Impulse Discharges in the Nerves of the Crab —S Zuckerman and Dr A S Parkes The Œstrous Cycle of the Hamadryas Baboon —Samson Wright Action of Adrenaline and Related Substances on Respiration —*Demonstrations* —I de Burgh Daly and W V Thorpe A Variable Cam Poppet Valve for Negative Pressure Respiration —I de Burgh Daly A Brodie-Starling Kymograph Extension for Doubling the Recording Surface —Prof E D Adrian Persistent Discharges from Injured Nerve Fibres —C A G Wiersma An Experiment on the

Resonance Theory of Muscular Action —H Taylor The Effect of Hydrocyanic Acid on the Total Ventilation —Prof J Barcroft, A Dale, G Endres, B Matthews and H Taylor Circulatory and Respiratory Phenomena in the Marmot —E N Willmer and L P Kendal Apparatus for Obtaining Photographic Records of Tissues growing *in vitro* —Alison S Dale Apparent Effect of Vague Drugs on the Ventricle of the Perfused Mammalian Heart —Prof J Barcroft Some Points in Blood Gas Technique —B H C Matthews (*a*) The Response of a Single Sensory Nerve Ending (*b*) A Simple Amplifier for Class Use —A Hemingway An Adaptation of the Montgomery Lipscomb Flow Recorder

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section) (at Torquay)

SUNDAY, MAY 11

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section) (at Torquay).

MONDAY, MAY 12

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4 30 —Prof J Garstang Joshua and the Higher Critics.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5 — Major K Mason and others Discussion on Nomenclature in the Himalaya

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Sir Arthur Keith The Anatomy of Fossil Man A Review of the more Recent Discoveries of Fossil Man made in Africa

CHEMICAL INDUSTRY CLUB at 8 —Dr H Moore Waves and Quanta

MEDICAL SOCIETY OF LONDON (Annual General Meeting), at 8 —Sir Arthur Keith Modern Medicine and Evolution (Annual Oration).

ROYAL IRISH ACADEMY (Dublin)

TUESDAY, MAY 13

ROYAL SOCIETY OF MEDICINE (Therapeutics and Pharmacology Section) (Annual General Meeting) at 5 —Sir James Purves Stewart and others Informal Discussion on The Treatment of Disseminated Sclerosis

INSTITUTION OF CIVIL ENGINEERS, at 6 —Annual General Meeting

IRON AND STEEL INSTITUTE (at Royal Metal Exchange, Swansea), at 6 30 —E Mort Tin and Sheet Mill Rolls Their Treatment, Performance, and Premature Failure in Service —R Whitfield Single Sheet or Thin Pack Normalising, or Heat Treatment *versus* Box Annealing of Sheets —A R Page and J H Partridge The Properties of some Steels containing Chromium

INSTITUTE OF MARINE ENGINEERS, at 6 30 —E W Green Developments in Powdered Fuel Practice for Marine Service

QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street W 1) at 7 30 —Exhibition by D J Scourfield of Lantern Slides of Marine Organisms prepared by Dr Sorby —G Tandy A Botanist on the Great Barrier Reef

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8 30 —H A Stayt The Bavenda

WEDNESDAY, MAY 14

ROYAL COLLEGE OF SURGEONS OF ENGLAND at 5 —Sir Arthur Keith The Anatomy of Fossil Man An Account of Human Fossil Remains discovered in Pleistocene Deposits of China and described by Prof Davidson Black

ROYAL SOCIETY OF MEDICINE (Surgery Sub Section of Proctology) (Annual General Meeting) at 5 —Sir Charles Gordon Watson (who will show a film illustrating the treatment, followed by M Lacassagne) S Cade Mr Lockhart Mummery, W S Perrin, and others Discussion on Radium in Cancer of the Rectum and Colon

GEOLOGICAL SOCIETY at 5 30 —C Barrington Brown The Geology of North Eastern British Somaliland

SOCIETY OF RADIOGRAPHERS (in Reid Knox Memorial Hall), at 7 —C H Holbeach The Planning of an X Ray Department.

SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (jointly with Coke Oven Managers Association—Northern Section) (at Armstrong College, Newcastle upon Tyne) at 7 30 —Dr F S Sinnatt Cenospheres and the Structure of Coke. —J H Carlisle and Dr F S Sinnatt The Formation of Cenospheres as a Means of Studying the Swelling Capacity of Coal

ROYAL SOCIETY OF ARTS at 8 —C E Douglas Rice Cultivation and Treatment

THURSDAY, MAY 15

ELECTRICAL ASSOCIATION FOR WOMEN (at Park Lane Hotel Piccadilly), at 11 15 A M (Annual General Meeting) —From 8 to 10 30 (at Institution of Electrical Engineers).—Reception.—L B Atkinson Some Electrical Reminiscences

ROYAL SOCIETY, at 4 —Election of Fellows —At 4 30 —Prof H E Armstrong The Origin and Nature of Coal and Chars —Prof E V Appleton and A L Green On some Short Wave Equivalent Height Measurements of the Ionised Regions of the Upper Atmosphere —M L E Oliphant The Liberation of Electrons from Metal Surfaces by Positive Ions I —M L E Oliphant and P B Moon The Liberation of Electrons from Metal Surfaces by Positive Ions II —*To be read in title only* —Prof E V Appleton and J A Ratcliffe On some Simultaneous Observations on Downcoming Wireless Waves —S Ramachandra Rao (*a*) Total Secondary Electron Emission from Polycrystalline Nickel (*b*) Total Secondary Electron Emission from a Single Crystal Face of Nickel —N F Mott The Scattering of Electrons by Atoms —J Hargreaves The Effect of Nuclear Spin on the Optical Spectra III —H S W Massey Scattering of Fast Electrons and Nuclear Magnetic Moments —J L Burchnell and T W Chaundy Commutative Differential Operators. II.—Prof W A Bone, L Horton, and S. H Ward Researches on the Chemistry of Coal VI —L C Jackson and L F Broadway An Application of the Stern Gerlach Experiment to the Study of Active Nitrogen —Prof O W Richardson The Emission of Secondary Electrons and the Excitation of Soft X Rays —G Temple The Operational Wave Equation and the Energy Levels of the Hydrogen Atom —A Eagle and R M Ferguson On the Coefficient of Heat Transfer from the Internal Surface of Tube Walls —O H Wansbrough Jones (*a*) The Interaction of Oxygen with Nitrogen after Collision with Electrons, (*b*) The Formation of Ozone from Oxygen after Collision with Electrons.—Prof T M Lowry and C P Snow The Optical Rotatory Power of Quartz on either Side of an Infra Red Absorption Band —Sir William Hardy Problems of the Boundary State —F Francis S H Piper, and T Malkin The *n* Fatty Acids.—Dr H Jeffreys The Wake in Three Dimensional Fluid Flow — L Rosenhead The Spread of Vorticity in the Wake behind a Cylinder — S. Venkateswaran and S Bhagavantam The Raman Spectra of some Aldehydes and of Mesitylene — M Ritchie The Density and Compressibility of Phosphine Gas the Atomic Weight of Phosphorus —E A Moelwyn-Hughes Phloridzin An Investigation of Certain of its Chemical Properties and its Behaviour towards Saccharolastic Enzymes —L J Freeman The Spectra of Trebly Ionised Oxygen (O IV) and Trebly Ionised Nitrogen (N IV) —A Elliott The Absorption Spectrum of Chlorine II —G Temple The Group Properties of Dirac's Matrices —Prof O W Richardson and U Andrewes A Comparative Study of the Excitation of Soft X Rays from Single Crystal Surfaces and from Polycrystalline Surfaces of Graphite and Aluminium —Prof O W Richardson and S Ramachandra Rao (*a*) The Excitation of Soft X Rays from some Polycrystalline Metal Surfaces (*b*) The Excitation of Soft X Rays from a Single Crystal Face of Nickel

LINNEAN SOCIETY OF LONDON at 5 —H R Hewer Studies in Colour Changes in Fish Part 5. The Colour Patterns in Certain Flat-fish and their Relation to the Environment.—Dr E M Delf The Release of Oogonia in the Fucaceae

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5 —Prof G I Taylor Recent Work on the Flow of Compressible Fluids (Lecture)

INSTITUTION OF ELECTRICAL ENGINEERS, at 6 —Annual General Meeting

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College Dublin) at 7 45 —Annual General Meeting

CHEMICAL SOCIETY at 8 —D C Jones and L Outridge Adsorption by Silicic Acid Gel in the System *n* butyl Alcohol benzene —B W Bradford and G I Finch On the Dielectric Strengths of some Explosive Mixtures containing Carbonic Oxide

ROYAL SOCIETY OF TROPICAL MEDICINE, at 8 15 —Dr H M Shelley Pellagra in Nyasaland

BRITISH INSTITUTE OF RADIOLOGY (Annual General Meeting) (in Reid Knox Memorial Hall), at 8 30 —Dr P J Kerley The Pathology of Early Pulmonary Tuberculosis as revealed by X Rays

INSTITUTION OF ELECTRICAL ENGINEERS (Hampshire Sub Centre) (at Southampton)

INSTITUTION OF MINING AND METALLURGY (at Geological Society)

FRIDAY MAY 16

ROYAL SOCIETY EDINBURGH at 4 30 —Prof G Wiegner Base Exchange (Address).

BRITISH INSTITUTE OF RADIOLOGY (Medical Meeting), at 5 —Radiology in Urinary Diseases and General

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Sir Arthur Keith The Anatomy of Fossil Man The More Recent Discoveries of Neanderthal Man in Europe The Present Position of the Neanderthal Problem

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at Dundee Technical College), at 7 30 —R H Fowler Some Recent Advances in the Electron Theory of Metals (Kelvin Lecture).

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynaecology Section), at 8 —Annual General Meeting

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Dr C M Yonge The Great Barrier Reef of Australia

ASSOCIATION OF ECONOMIC BIOLOGISTS (at Forest Products Research Laboratory, Princes Risborough)

SATURDAY, MAY 17

PHILOLOGICAL SOCIETY (jointly with Oxford Philological Society) (at Magdalen College, Oxford), at 5 30

PUBLIC LECTURES

MONDAY, MAY 12

LONDON (R F H) SCHOOL OF MEDICINE FOR WOMEN at 5 30 —Dr A Lacassagne Treatment of Uterine Cancer by Radiations. (Succeeding Lectures on May 13 and 15)

TUESDAY, MAY 13

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 5 30 —Prof A. J Kluyver The Chemical Activities of Micro organisms (Succeeding Lectures on May 15 and 16)

UNIVERSITY COLLEGE at 5 30 —Prof W E Blatz Modern Theories in Habit Training in the Pre School Child

WEDNESDAY, MAY 14

SOCIETY FOR CULTURAL RELATIONS BETWEEN ENGLAND AND U S.S R (at London Central Y M C A , Tottenham Court Road), at 8 30 —J G Crowther Science in Soviet Russia

THURSDAY, MAY 15

UNIVERSITY COLLEGE at 2 30 —Sir Flinders Petrie Recent Discoveries at Beth Pelet, Palestine (To be repeated on May 24 and 26)

INSTITUTE OF PATHOLOGY AND RESEARCH, ST MARY'S HOSPITAL PADDINGTON at 5 —Dr Leonard E Hill The Physiology of Diving

ROYAL SANITARY INSTITUTE, at 8 —E Willis The Collection and Disposal of Refuse (Chadwick Lecture).

CONGRESSES.

FRIDAY, MAY 16

SOCIETY OF MEDICAL OFFICERS OF HEALTH (at Harrogate) at 4 —Discussion on Rheumatism in its Public Health Aspects

MAY 19, 20, AND 21

INTERNATIONAL CONGRESS ON MALARIA (at Algiers).

SATURDAY, MAY 17, 1930

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No 3159, Vol 125]

The Rules of Zoological Nomenclature

AS already announced in NATURE, the International Zoological Congress will meet at Padua next September A week before the Congress opens, the International Commission on Zoological Nomenclature will resume its sittings so as to report to the Congress on numerous cases that have been submitted for its opinion and on certain important proposals that have been under consideration since the last Congress It is useful to remember that this Commission has carried on its work continuously since its appointment in 1895 Even during the War its members were in correspondence, and, though a longer interval than usual elapsed between the Congresses, there was no break of any kind The composition of the Commission of eighteen members has continued subject to the bye laws, according to which members are elected for a term of nine years and one third retire triennially Thus the wisdom of experience is seasoned with new ideas Criticism has been levelled at the constitution of the Commission, but it is difficult to devise any better method Great care is taken that the various branches of systematic zoology and the different parts of the world should be represented A commissioner must be interested in the subject and must have access to a good library, but no attempt is made to seek out the holders of particular opinions

However such an international body be appointed, and with whatever care it weighs the arguments, its decisions cannot please everybody It would be absurd to suppose that all zoologists could agree on these disputed questions Inevitably also there is perennial conflict between the general zoologist and the specialist, between the morphologist and the systematist It seems obvious that the decision must rest with those who are constantly dealing with names and have studied the principles of nomenclature, but since the Congress at Monaco the Commission has accepted fairly the compromise there agreed upon, by which the rules may be suspended when their rigid application would lead to worse confusion

At Budapest, in 1927, the Commission spent several days in attempting to meet the views of many critics No final decision was reached, but certain amendments were suggested in the Commission by way of compromise, and they have to be finally voted on at Padua An account of these and other proposals of later date was recently given by the Secretary of the Commission, Prof C W Stiles, to the International Congress of

Entomology, and is published in its *Transactions* (**4**, pp 622 645) Some of them may be mentioned here

At an early date the Congress refused to receive from the Commission any amendments to the rules that had not received a unanimous vote in Commission Of recent years the view has gained ground, particularly in Europe, that this permitted an obstinate minority (possibly of one) to bar generally desired reforms, and it has been pro posed that any amendments which obtain a majority vote in Commission should be reported to the Congress and decided by it in open meeting This plainly goes too far in the other direction and it is not surprising that the Commission has rejected it twice It is, however, to come up again, and a compromise has been proposed, as follows

"At least all those proposals for amendments to or additions to the International Rules of Zoo logical Nomenclature which have obtained—*first*, a majority of five sixths of the total membership of the Commission of Nomenclature for the time being, and *subsequently*, five sixths of the votes of those present at the meeting of the Commission, shall be the recommendations of the Commission to the Congress"

This has been countered by a proposition that "The stability of the rules is a prime and funda mental principle" Theoretically, most workers will accept this, for constant revision of the rules would be disastrous It is further argued that rules based on a unanimous vote should not be altered except by unanimous vote The practical question seems to be whether a rule which experience has shown to be objectionable should be modified soon or at a later date No doubt impracticable or unwise proposals will be made from time to time, but it is highly improbable that they would ever gain the votes of five sixths of the Commission On the other hand, it does seem probable that any pro posal supported outside the Commission by a large body of working zoologists and inside it by fifteen of its eighteen members would some day gain the suffrages of all the Commissioners Is anything gained by postponing that day ?

Other proposals that fall to be discussed this year concern type designation by elimination, the acceptance of generic names used by non binominal authors, and the change of starting point from Linnæus' 'Systema Naturae", Ed X to Ed XII This last would, if accepted, throw an enormous amount of work accomplished during the past thirty years on to the scrap heap, but its acceptance is in the highest degree unlikely

It is a somewhat curious fact that on all these questions except the last there is an apparent cleavage of opinion between American and European zoologists If one could discover the true reasons for this divergence, one would probably arrive at the best solution of the matters in dispute Some will tell us that the American pack merely comes to heel at the call of Prof Stiles, an absurdity that carries its own refutation to anyone acquainted with American conditions Perhaps one reason is to be found in the mentality that leads citizens of the United States to organise their activities, whether of business or sport, on lines of mechan ical thoroughness manifest in such apparatus as rationalisation, classifications, card indexes, and rules The Englishman, if not the European at large, prefers freedom to over much legislation He is quite as law abiding as any American, and has indeed so high a respect for the law that he will not pass laws unlikely to be obeyed and is ready to reform those that prove harmful

Prof Stiles maintains that, because eighteen (or fewer) people have once unanimously agreed on a rule, that rule should never be altered except by unanimous vote At the outset unanimity was forced on the Commission by the Congress, and it looks as though the Commissioners were conse quently more unanimous in their votes than they were in their opinions, for the sake of getting some thing done Anyone with experience of committees knows how often practical considerations lead him to vote for a proposition with which he does not fully agree If now there is a real demand by zoologists that the power of veto resident in any single commissioner should be taken away, and a five sixths effective majority substituted, is there any good reason why the Commission should not accept this and thus conciliate the opposition ? The further reason given by Prof Stiles is that the rules should be stable in principle and that any reversal would be disastrous With this thesis most zoologists will doubtless agree, though there might not be such general agreement on what is a principle and what is not, and some might claim that a non retroactive change is not a reversal However that may be, it appears highly improb able that when rules have been maintained for thirty years on a unanimous basis, any serious alterations will win the votes of five sixths of the Commission Important as the stability of the rules doubtless is, it is no less important that they should be generally accepted and applied The Commissioners may be so immovable that the flood of zoologists will pass them by

International Trade

Unsolved Problems National and International By John S Hecht Pp 288 (London Jarrolds Publishers (London), Ltd, 1930) 16s net

ON April 25, 1835, the Académie des sciences morales et politiques—one of the five academies comprising the Institut de France in Paris—announced a prize competition, and offered the sum of 3000 francs for the best essay in answer to the following question

"When a nation intends to establish free trade (la liberté du commerce), or to modify its tariff laws, what are the facts which it ought to take into consideration in order to reconcile in the most equitable manner the interests of producers and of consumers?"

Among the competitors was a German engineer, Friedrich List, whose name is among the greatest in the annals of economics, and who, after devouring all the works on political economy he could find in the great Paris bibliothèque, wrote out his essay in feverish haste, working day and night The result was an elaborate treatise on economics which, although it did not win the prize—the prize was not, in fact, won by anybody—formed the basis of his subsequent work on a national system of political economy

The prize was not won, and now after nearly a hundred years it seems that the world still awaits a satisfactory solution of the above problem, although it is now stated in a rather more comprehensive form, and with less emphasis on the distinction between producers and consumers It is a problem which, in so far as its solution appeared to lie in the direction of free trade, has always profoundly interested the scientific world, for, justly or unjustly, the doctrine of free trade has always appeared to have a sounder scientific foundation than any sort of protectionist theories which, on the contrary, appeared to rest on a merely empirical basis, grounded in expediency, self interest, and sheer opportunism Free trade seemed also to have an even higher and nobler origin in or association with that philosophy of freedom and liberty which shone so clearly and strongly in eighteenth century thought, and it is no wonder that it appealed powerfully to both philosopher and scientific worker, and that the most learned body in Europe, nearly a hundred years ago, deemed it not beneath its most serious consideration, but some shadow of doubt is now emerging whether free trade really deserves this rich cloak of aristocratic association whilst protectionism shivers in the rags of empiricism In the most authoritative work yet published on the history of economic doctrines (that of Profs Gide and Rist) it is stated that

"If there is one lesson more than another that emerges from a study of the history of economic doctrines it is the necessity for a more critical spirit and a more watchful attitude, always ready to test any new truths that present themselves, to extend a hearty welcome to every fresh observation or new experience, thus enabling the science to enlarge its scope and gain a deeper significance without sacrificing any of its essential tenets"

One presumes, in passing, that the only real test of new truth is practical experiment, even in the social sciences, that indeed a vast amount of experimentation in the social sphere has been an outstanding feature of the last twenty or thirty years, that such experiment should be continued and extended and the results collected and collated with the utmost possible diligence and mental acumen, and that all real or imaginary association with worn-out theories or philosophy should be broken

This and the above quotation may be said to form the basis of Mr Hecht's new book, which may be strongly recommended for close study by everyone interested in commercial and industrial problems, and who to day is not interested? He says that our chief problems nowadays are naturally of an economic order, and the most pressing of them, because inability to solve it calls for doles with their demoralising influence, is unemployment There is not enough work to go round, which seems strange when one considers that out of every hundred individuals the material desires of ninety nine are unsatisfied Then there are the correlated problems concerning agricultural and industrial depression, the insufficiency of the national dividend and consequent burden of taxation, and the restriction of credit Further, what is the reaction of foreign commerce on the aforesaid problems? Some think that their solution and the prevention of ill-will among nations lies in freer trade and buying in the cheapest market Others are equally convinced that for Great Britain the right policy is safeguarding and buying within the Empire Can these things be put to the test of practical experiment, or must they for ever form the burden of endless argument and exacerbated controversy? Mr Hecht considers that the pivot of all these problems, both national and international, is wages, and it is mainly from the point of view of wages that he seeks, and claims to have found, a solution both of the wages problem or just distribution of wealth, and of the safeguarding problem and abatement of

international discord The French Academy offered a prize of 3000 francs The British nation might well offer a prize of £3,000,000 to anyone finding a satisfactory and practical solution of these weighty and hitherto intractable enigmas

There is not space here to do justice to Mr Hecht's discussion of the wages problem in the first part of his book, and we must confine our attention to a brief examination of the second part, treating of international trade, with special reference to free trade and safeguarding He at least has no respect for free trade because of its affected association with an old and worn out philosophy or pretence at scientific form It does not indeed exist in real life, and is a mere abstraction In regard to Great Britain it would be quite justifiable to say that, so far from being scientific, it is not even correct in its name, and surely it is hopelessly unscientific to make a serious mistake right at the outset in terminology Trade consists in exports as well as imports, and whilst the British export trade is hampered and shackled and overwhelmingly burdened with high tariffs in nearly every market in the world, it cannot, except by a most ridiculous distortion of the truth, be called in any sense of the word free A system merely of free imports is vastly different from free trade as understood by its greatest exponent, Adam Smith, and to seek to uphold such a one sided system under a false name is not science and is morally indefensible

Mr Hecht insists on the profoundly important distinction between complementary imports and competitive imports Forty or fifty years ago the imports into Great Britain were mainly complementary and consisted in those things, largely raw material, which we could not produce ourselves at home But as other nations became more advanced and industrialised the character of our foreign trade underwent a radical change, and our imports became largely competitive Mr Hecht shows that complementary imports decrease production costs and raise wages by economising labour, and by keeping labour and capital employed in those industries where both profits and wages are high He shows further, or certainly makes out a strong case for the contention, that competitive imports on the contrary increase production costs by reducing the efficiency of home industries and the possibility of mass production Moreover, the cost of producing anything depends on another factor, namely, the continuity of demand, or in other words an assured and adequate home market "To expect industrial enterprise," says Mr Hecht, "if an article is to be made at home one day and imported on the morrow is absurd" But foreign competition in the home market is always variable in the absence of tariffs one can be sure that it will be intense, but the degree of intensity cannot be predicted For the same reason the export markets are generally unstable, and little planning ahead for future demand — so essential for minimum costs — is possible Therefore we may conclude that competitive imports involve the loss of what would be a certain and stable home market for what is necessarily an uncertain and unstable foreign market

"Competitive imports destroy the stability of home industries, and cause thereby a twofold increase in production costs For, first, although these imports must be paid for by exports, industrial or commercial instability makes capital unproductive by leaving it standing idle, secondly, industrial or commercial instability makes labour unproductive by provoking unemployment" (See Chaps v and vi in the original)

The author next proceeds to examine a further disastrous effect of unrestricted competitive imports, namely, that of lowering the quality of home industries It is fairly well known by every British manufacturer that the keenest competition from abroad is in those industries where profits and/or wages are high, and where there is the maximum scope for price cutting The ultimate effect of foreign competition, that is, competitive imports, is to drive labour and capital from those higher grade industries into those of lower grade where both profits and wages are lower This degradation in British industry has been going on constantly for the last thirty or forty years, so that to day the leading industries are low grade wherein profits are almost negligible and wages down to a minimum, for example, in coal mining, in many branches of the textile industries, in shipping, and in several others

Britain's three principal exports—coal, textiles, shipping (this latter paying for imports by services)—are low grade in the sense that both wages and profits are very low, whereas German and American exports are the products of high grade industry This is well illustrated by the character of the trade in textiles between Germany and Great Britain in 1913 In that year Great Britain exported to Germany hosiery, lace, cotton gloves, and other highly finished textiles to the value of only £633,776, whereas her imports from Germany in the same class of goods were £4,328,185 Of cotton waste and yarn (low grade semi manufactured textiles), British exports to Germany amounted to £5,662,872,

and her imports from Germany £443,028 This was in 1913, and the position from the British point of view has become much worse since then It shows clearly that Germany is getting more and more of the trade in the higher class highly finished textiles and leaving the lower grade branches, of low wages and lower profits, to Great Britain This change in the *quality* of British industry and British exports is one of the most momentous in the industrial history of the country, and is not sufficiently appreciated in all its implications

A further charge in the indictment of our so called 'free trade', more correctly free or competitive imports, is contained in its effect on agriculture Mr Hecht very truly says that home grown food is our natural food, imported food cannot be so fresh and is liable to deterioration, so that the health and productive power of a people dependent mainly on imported food must suffer Also the import of agricultural produce drives labour from the village into the town "But agriculture is undoubtedly the healthiest industry known to man It breeds a virile race Consequently, competitive imports increase production costs by impairing the salubrity of home industries" It may be that Mr Hecht is not on quite such sure ground here as in other parts of his indictment, but he does make out a strong case for his main contention, that is, that competitive imports lower wages in home industries, and that universal free trade would reduce wages throughout the world, down indeed to the level of the lowest paid labour, such as that of India, China, or Japan

In a chapter showing how the current theory of international trade came to be tolerated, the author comes to the conclusion that that theory is well nigh inexplicable in all its various postulates, including the assumptions that all imports economise labour, that the amount of labour economised is incalculable, that money pays for imports That theory has indeed originated in the same false principles as the current theory of wages, and he quotes Sir William Ashley ("A Retrospect of Free Trade Doctrine") at great length in support of his denunciation thereof The last two chapters in an excellent work, which should be closely studied by everybody, deal with the influence of money on international trade, and with the safeguarding problem In his examination of an exceedingly intricate, difficult, and highly contentious field the author has endeavoured to keep as closely as possible to the actual facts of our present industrial position, and shows, moreover, a fairly comprehensive grasp of the voluminous literature of the subject dealt with, as evidenced by the exhaustive documentation which supports the book It is an invaluable contribution to the elucidation of the vital problems which now seem to involve the very existence of the British nation W G LINN CASS

Preservation of Scenery in the Thames Valley

The Thames Valley from Cricklade to Staines a Survey of its Existing State and some Suggestions for its Future Preservation Prepared by the Earl of Mayo, S D Adshead, and Patrick Abercrombie, with the assistance of W Harding Thompson, for the Thames Valley Branch of the Council for the Preservation of Rural England Pp xvi + 106 + 34 plates + 6 maps (London University of London Press, Ltd, 1929) Limp cloth, 15s net, cloth boards, 21s net

THE publication of this handsome quarto volume with fine type and good paper, admirably illustrated and well provided with specially prepared maps, will serve to mark an epoch in the history of landscape planning Before the Industrial Revolution, the wealthy landowner planned the environment of his mansion so that garden, open pasture of the park, woodland, and arable, combined economic efficiency with pictorial grouping The time has now come when the nation should take control of the countryside and plan its development so as to combine the conditions of economy and beauty

The charms of the Thames side between Cricklade and Staines are described by the authors of this book with a restrained enthusiasm in keeping with the quiet beauty of the country itself, thus predisposing the reader to a sympathetic consideration of the constructive proposals for preservation of beauty under progressive conditions The riverside towns are dealt with in succession, particular attention being given to by pass roads and other means for preserving the charms of the old High Street, and the use and preservation of every ancient bridge is carefully considered The excellent photographs of these monuments remind us of the fact that in the shadowing of its arches an outdoor viaduct excels the beauty of nave or aisle, and that the arches which span a smooth stream excel those of the viaduct because of their etherealised reflection

The most important, and perhaps the most novel, proposals are those relating to the prevention of building on the broad, flat meadows

which lie in the embrace of the river's curve To the unwary visitor, these appear attractive for residence, or at the least for the week end bungalow, but are in fact unfitted for any dwelling place The ground is always waterlogged at a level little below the surface and is in most cases liable to flood, so that the site is unhealthy for the occupant A still more important drawback is the difficulty of providing for disposal of sewage and of preventing contamination of the river It is needful, moreover, that the river should be allowed to spread over these meadows in seasons of heavy rain, thus preventing sudden and excessive rise of level in the lower reaches

When we turn from the hygienic to the æsthetic aspect of the matter we find that it is a requirement of scenic grouping, or 'landscape composition', to keep these broad, flat meadows free from buildings, for they are the foil of riverside towns and wooded bluffs, and also essential to the prospect from the opposite, higher bank, from which we obtain the wider view of the Thames Valley and its background of distant hills

The Council for the Preservation of Rural England has only been in existence for three years, but its influence upon public opinion is already so great that there is every reason to hope that the proposals put forward on behalf of its Thames Valley branch will receive careful and sympathetic consideration VAUGHAN CORNISH

Fossil Brains

Die fossilen Gehirne Von Tilly Edinger Pp 249 (Berlin Julius Springer, 1929) 36 gold marks

THE best results in science have been obtained mostly by combining two hitherto separate branches or methods The author of the work before us is a daughter of the late Prof Ludwig Edinger, who is well known as one of the founders of the comparative anatomy of the brain She grew up, therefore, in a very centre of comparative neurology, and having also studied palæontology from the geological point of view, she joined these two branches in a remarkable manner in *palæo neurology*, which is not an entirely new combination, but has never been practised so thoroughly and methodically The chance to make errors in this field is greater than anywhere else For, as the author acknowledges in the very beginning of her book, a fossil thigh bone is a thigh bone anyhow, but a 'fossil brain' is not a brain at all it is—with a few exceptions—only a natural (petrified) or artificial endocranial cast of a fossil skull By this fact we know more of the central nervous system of many fossil animals than, for example, of their intestines, but to interpret the data with accuracy we must begin by studying in recent animals the relations between the brain and the form of the endocranial cavity, which is in many cases much more spacious than would be necessary to contain the brain only These and other methodical and technical matters are discussed in detail and elucidated with many illustrations in the general part (pp 9-100) of the book

Dr Edinger has tried to write a clear and instructive book for neurologists, for whom so many names of geological periods and fossil animals are mere 'words', as well as for palæontologists not versed in the neurological 'jargon', and in this she has been successful

The other part of the book is a copiously illustrated critical compilation (classified according to the zoological system) of all that is known about the central nervous system of fossil vertebrates, and it is more than a compilation only, for the author, guided by her great experience on the subject, often gives her own interpretation of the facts The alphabetical bibliography (250 entries !) has the practical feature that not only are the titles cited, but also with every article a brief mention is made of what it contains referring to the subject in question

In conclusion, some of the problems of general interest dealt with in the chapters may be mentioned Marsh's 'law' suggesting that the species that proved to be the 'fittest to survive' had comparatively larger brains than the extinct forms, is not generally confirmed Technical masterpieces of palæoneurology are the reconstructions of the endocranial cavity with all canals and openings in fossil fishes, made by Stensiö It is confirmed that some of the giant forms among fossil animals had small brains, but a relatively giant hypophysis The sacral dilatation of the spinal canal in *Stegosaurus* is discussed in detail The brain of the flying reptiles (Rhamphorhynchoidea and Pterodactyloidea) had many bird-like features, while the brain of the contemporary *Archæopteryx* was still more of the reptile type The typical form of the bird's brain seems to be in connexion with the function of flying Like other organs also, the fossil brains make it clear that both birds and mammals have developed gradually from reptiles, this evolution is partly a relative increase of the fore brain The brains of fossil Anthropoidea are described in a special chapter

P J VAN DER FEEN, JR

Our Bookshelf

Reports of the Progress of Applied Chemistry Issued by the Society of Chemical Industry Vol 14, 1929 Pp 775 (London Society of Chemical Industry, 1930) 7s 6d to Members, 12s 6d to non Members

The publication of a new volume of the annual reports of the progress of applied chemistry recalls the strange fact that there are still some industrial chemists who have never used, never even heard of, this excellent review Chemists are usually busy people, and busy people cannot be expected to read extensively the literature of those parts of the science with which they are not immediately concerned They ought to do so, they admit, but can find neither time nor capacity for the enormous task Nowadays, a chemist who claims to be well informed is not necessarily a voracious reader of original papers, even in his own language, but is often one who, at least for his non essential study, relies on records such as that under review, afterwards using them for the selection of the relevant literature to be consulted How often do we now read not to acquire information but to discover where it is to be found! Moreover, only the favoured few can afford to maintain a reasonably adequate chemical library, most of us are content, so far as journals are concerned, to keep the annual reports on pure and applied chemistry at hand and the corresponding abstracts within reach By so doing we can at least rely on being kept in close touch with the development and application of chemical science

The present volume covers the same ground as its immediate predecessor with the exception of explosives, in which domain the survey is biennial The chapters on general, plant, and machinery (R Edgeworth Johnstone), fuel (J G King), refractories, ceramics, and cements (W C Hancock), iron and steel (C O Bannister), india rubber (H P Stevens and W H Stevens), leather and glue (D Woodroffe), foods (L H Lampitt), sanitation and water purification (J H Coste), fine chemicals, medicinal substances, and essential oils (E Stedman), and photographic materials and processes (F M Hamer) have been entrusted to authors who were not concerned in the preparation of last year's report, the remainder of the twenty four chapters have been contributed by the same authors as in 1929, either alone or in collaboration A A E

Laboratory Guide to Vertebrate Dissection for Students of Anatomy By Dr A B Appleton Pp xix + 152 (Cambridge At the University Press, 1929) 6s net

As its title indicates, this is a book for use in a practical comparative anatomy course It is intended for a somewhat unusual class of student, and consequently its contents, outlook, and method of treatment are unlike those of the standard texts in this subject As stated in the preface, it is assumed that the student has already done a course in elementary zoology, including the usual vertebrate types, and has also examined in more detail a mammal Unless this mammal were man, a number of comparisons in the book would be missed To obtain full benefit from it the student should obviously have taken the preliminary medical studies, including a fair amount of human anatomy This is not meant to imply that the student of advanced zoology cannot get many useful hints and fresh points of view from its pages, he undoubtedly can The types, treated in a series of regional dissections, are the lamprey, the dogfish (*Squalus*), *Necturus*, the lizard, and the dog As it is intended for assistance in dissection, information regarding osteology and the details of the central nervous system have been purposely omitted and, conversely, the muscles are treated somewhat more fully than is customary

In applying, so far as possible, the International (Basel Nomina Anatomica) Code of Nomenclature, the author has set a commendable example that might be followed with advantage by other works in comparative anatomy On p 28 it is stated that from the union of the pre and post trematic arteries dorsal of the first gill cleft two vessels arise "the first efferent branchial artery and the internal carotid artery (lateral dorsal aorta)" The former is better termed the first epibranchial and the latter is the hyoidean epibranchial—it is certainly not the internal carotid or the lateral dorsal aorta, as a glance at Scammon's reconstruction of these vessels in the embryo would show

Atmospheric Corrosion of Metals Third (Experimental) Report to the Atmospheric Corrosion Research Committee (British Non Ferrous Metals Research Association) A Discussion held by the Faraday Society, 23rd May 1929 Pp 173 252 + 475 502 (London The Faraday Society, 1929) 5s 6d net

Previous reports to the Atmospheric Corrosion Committee have been concerned with laboratory experiments, and most interesting results have been obtained regarding the part played by an initial film of tarnish in determining the subsequent course of corrosion, especially of copper and its alloys In the present state of our knowledge of corrosion, such carefully designed and executed experiments are of far greater value than a mere accumulation of empirical data, the number of which is already far too great It was necessary, however, to confirm the laboratory results by field tests, and the latest report describes a systematic series of such tests, utilising the conclusions of the earlier work

As is usual in field tests of corrosion, the results are by no means simple, and in fact the total amount of corrosion was so small as to suggest that typical non ferrous metals should last for very long periods, even in industrial atmospheres Much depends on the amount of exposure to rain, as the corrosion when the soluble products are continually removed may take a quite different course from that taken when the products accumulate as a crust For wire specimens, the change of electrical resistance gives a fair measure of the

extent of the corrosion The effect of humidity and of the formation of deliquescent products is clearly brought out, and the results are of undoubted value In practice, local attack due to the concentration of the effects on a small portion of the exposed surface must play a large part in determining the life of a material, general corrosion having little effect

La diffusion moléculaire de la lumière Par Jean Cabannes, avec la collaboration d'Yves Rocard (Recueil des Conférences Rapports de Documentation sur la Physique, Vol 16) Pp viii + 326 (Paris Les Presses Universitaires de France, 1929) 65 francs

THE scattering of light by small particles observed by Tyndall was studied exhaustively by Lord Rayleigh, who showed in 1871 that each particle, assuming its dimensions small in comparison with the wave length, sets up a secondary disturbance which travels in all directions In 1899, Rayleigh concluded that the blue colour of the sky could be accounted for by the scattering of light by molecules of the atmosphere In the book under notice, the author seeks to establish a coherent theory of the diffusion of light in the interior of a fluid on the assumption that the incident wave excites in each molecule a movement proportional to the field, these little induced doublets vibrate with the frequency of the exciting wave and in their turn radiate diffused light

Although the idea of such molecular diffusion is comparatively modern, we are confronted to day with an immense field of experimental and theoretical investigation The author has accordingly confined his attention almost entirely to the diffusion of ordinary light in the interior of pure transparent fluids, and only in an appendix does he refer to the Raman effect He has carried out a critical examination of the experimental results and also of the theoretical formulæ In the latter part of this work he has had the assistance of M Rocard, who contributes two chapters dealing with the character of the diffused light as the critical point is approached, and with the study of the 'critical opalescence' The volume should be of great service to future investigators

Discoveries and Inventions of the Twentieth Century By Edward Cressy Third edition, revised and enlarged Pp xxi + 476 + 177 plates (London George Routledge and Sons, Ltd, New York E P Dutton and Co, 1930) 12s 6d net

As the successor to Routledge's "Discoveries and Inventions of the Nineteenth Century", Mr Cressy's book has enjoyed considerable popularity First published in 1914, a second edition appeared in 1922, and to this further matter has now been added, and the number of illustrations has been increased No one, perhaps, realises the difficulty of attempting to deal with modern discoveries and inventions in one volume, or of keeping such a volume up to date, more than the author himself

Mr Cressy's book is written in the first place for the non technical reader, but we imagine many engaged in scientific work and engineering will find its chapters of great interest The ground covered is mainly that of power generation and transmission, transport by land and sea and air, communication by electricity, and such developments of chemistry and physics as may be included under the titles—soils and crops, the borderland of modern chemistry, applications of photography, radium, electricity, and matter Other subjects to which chapters are devoted are the electric furnace and refrigeration

Included in the text are many diagrams and photographs, the former being by far the more valuable to those wishing to know the why and wherefore Whether the non technical reader can understand the principle of the gyroscopic compass or the Ljungstrom steam turbine from the drawings given we are doubtful In the chapter on gas, petrol and oil engines, the Fullagar engine is unfortunately shown upside down, while the statement that the internal combustion engine used in ships is not reversible needs correcting

The Conduction of Electricity through Gases By Dr K G Emeléus (Methuen's Monographs on Physical Subjects) Pp x + 94 (London Methuen and Co, Ltd, 1929) 2s 6d net

THE phenomena of the electric discharge in gases are very striking in character and appeal strongly to those interested in physics Besides, they have received numerous technical applications But the subject is in reality complicated from an experimental point of view and is one which from a theoretical point of view is incompletely understood The nature of the discharge is due to the occurrence of many elementary processes (the most important of which are ion formation and the excitation of light) linked together in a way which is obscure Dr Emeléus has presented fairly the present stage of development of the subject, and, therefore, we welcome his little work even though we may regret that he has not had more space to develop his views, for then the book would have been more readable as well as more informative But in compensation it is very cheap, and since, within its limits, it is extremely well written, we have no hesitation in recommending it H W B SKINNER

The National Benzole Association Standard Specifications for Benzole and Allied Products, 1929 Pp xiii + 145 (London National Benzole Association, 1929) 6s net

MULTIPLICITY of standard processes has been avoided by the whole hearted adoption by the National Benzole Association of those portions of the "Standard Methods for Testing Tar and its Products" (see NATURE, April 26, p 631) appropriate to the examination of benzene, toluene, xylene, and naphtha In addition, there are given for various commercial grades of these materials, fourteen specifications, applicable only when the particular methods described are used Allowance is made for the addition of any further specifications or methods that may be made from time to time B A E

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Reflection of Positive Ions by Crystals

FURTHER experiments on the reflection of hydrogen positive rays from crystals, similar to those described in NATURE for Jan. 11, have shown that the phenomenon is more complex than might have been expected. More than a hundred photographs showing reflected rays have been obtained under various conditions, and they show several features of interest. Great differences have been found in the reflecting powers of different samples of calcite. Two were found that gave strong reflected rays when the glancing angle was less than two degrees. The images obtained on Schumann plates placed at right angles to the beam may be properly termed reflection patterns, as they show considerable complexity, vary in a regular manner with the angle of incidence, and can be reproduced at will with the same setting of the crystal and speed of the rays. Six other calcite crystals gave reflection patterns containing fewer lines or lines on a fogged background. Reflected rays were also observed with a diamond which was kindly loaned by Dr. D. Cooksey. A natural cleavage face of this diamond had been used in experiments on the reflection of gamma rays. A highly polished face gave indistinct patterns on a fogged background. Clear lines were obtained from two other faces, one of which was the natural cleavage face, and the other a face that had been cut and appeared rough due to saw marks. No reflected rays were found in a few trials with rock salt, galena, and magnetite.

The strongest parts of the patterns are produced by rays that have energies corresponding to more than six thousand volts. Slower rays may be present in the original bundle, as shown by a positive ray analysis, but they are not reflected so strongly as the faster rays. With a low potential on the discharge tube the reflection pattern lacks certain of the parts that appear with high potentials. A positive ray analysis of the ions reflected from one of the calcite crystals showed that in addition to the hydrogen atoms previously reported, all the positive ions in the original bundle are present in the reflection patterns, namely, hydrogen molecules, triatomic hydrogen molecules, and heavier ions that are probably oxygen atoms. With the present resolution, the various ions are superimposed in the streaks or lines formed by the reflected rays of various velocities.

The dependence of the angle of deviation by the crystal on the energy of an ion, rules out the possibility of ascribing the reflection to the deviation of particles by electrostatic forces, which would require the reflected rays of various velocities to lie in a plane, and to have angles of deviation inversely proportional to the energies of the particles. In most cases the reflected rays of different velocities do not lie in planes, as they give curved images on the plate, and in the cases where a straight line is formed the deviation is not inversely proportional to the energy but is a linear function of the reciprocal of the velocity. Charges would not be expected to accumulate on the crystal because of the secondary electrons liberated by the bombardment of metal parts near it, and its uncharged condition is shown by the fact that those rays which just pass over the crystal without hitting it are undeflected. The small penetration of the ions into matter, as compared with electrons of the same equivalent wave length, suggests that energy changes at the surface or inside the crystal will have to be taken into account in a complete theory. The important factor in determining the angles may be a quantity analogous to a refractive index which would depend on the energy of the ion and its alterations.

Small changes in the angle at which the incident rays hit the crystal produce a regular series of changes in the direction of the deflected rays. At nearly grazing incidence on one of the calcite crystals with the rays parallel to an edge of the cleavage rhomb, there was a fan shaped arrangement of the reflected rays in eight or more radial lines of different intensities. As the angle was made steeper, the lines formed by the reflected rays of various velocities shifted towards the normal to the crystal surface and became curved, the intensities altered, and new curved lines appeared at the sides, making the patterns more complex and more symmetrical. This change was produced by an increase of only one degree. With a second calcite crystal which was turned so that, at grazing incidence the rays made an angle of about fifteen degrees with an edge of the cleavage rhomb, clear patterns were obtained which had an unsymmetrical character. These patterns, as well as those from the diamond, also changed in a regular manner with small increases in the angle of incidence. The dependence of the angles of reflection on the angle of incidence and on the velocity of the rays suggests very strongly that a theory of the phenomenon will have to contain other elements besides particles and the forces exerted on them by electric and magnetic fields.

A. J. DEMPSTER.

University of Chicago, April 22.

A Point in the Theory of 'Critical Illumination' in the Microscope

IT is extremely difficult to give any general theory of the formation of the image in the microscope, inasmuch as the action differs with every different object and with the arrangement of the illumination. On the other hand, it is possible to give a satisfactory account of particular cases which throw light on the various 'simplifications' which have from time to time been put forward. Modern views are represented in a recent discussion on the Abbe theory (*Jour. Royal Mic. Soc.*, **49**, pp. 123-142 and 228-264, 1929).

A case which allows of simple treatment is that in which the illuminating system is imagined to be projecting the image of an axial point source symmetrically into the object plane. It may be assumed that the illuminating lens is free from aberration and that it has a rectangular aperture.

The distribution of amplitude in the plane then follows the usual law

$$a = \text{constant} \times \frac{\sin u}{u},$$

which is plotted in the thick curve of Fig. 1. Note that the amplitude may change sign, but the phase remains constant. The broken curve shows the relative intensity, represented by the square of the above function. As is well known, the central maximum is very large in comparison with the lateral maxima, which rapidly decrease in intensity. Similar results are found for the distribution of amplitude and intensity along the diameter of the 'Airy disc' characteristic of a circular aperture.

If A_i is the 'numerical aperture' of the illuminating

cone, the distance h between the central maximum and the first dark minimum ($u=\pi$) is given by

$$h=\frac{0\cdot 5\lambda}{A_t}$$

We may select a case where a grating, typified by a row of very small apertures, lies symmetrically in the

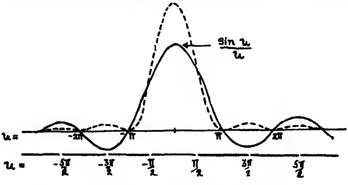


FIG 1 —Values of (sin u)/u, full curve, and (sin u)²/u², broken curve

object plane Then, selecting the spacing of these apertures as distant from the axis on each side by the intervals corresponding to

$$u=\pi/2,\quad 3\pi/2,\quad 5\pi/2,\ \text{etc},$$

it will appear that the amplitudes of the portions of the illuminating interference pattern exposed by the apertures are proportional to

$$2/\pi,\quad -2/3\pi,\quad 2/5\pi,\ \text{etc},$$

on each side

Consider now the central pair of apertures If each aperture is very small, the amplitude of the vibrations diffracted into various directions by one aperture will be fairly uniform The amplitude effect of the two in a direction taken in an axial plane containing the row of apertures and at an angle θ with the normal to the 'grating' will be

$$\text{amp} = 2a_1 \cos\frac{\pi x \sin\theta}{\lambda},$$

where a_1 is the amplitude due to one acting singly, and x is the spacing

The effect of the second pair is $2a_2\cos\dfrac{3\pi x\sin\theta}{\lambda}$

Thus the series representing the effect of the whole row becomes one of the type

$$f(\phi)=\frac{4}{\pi}\left(\cos\phi-\frac{\cos 3\phi}{3}+\frac{\cos 5\phi}{5},\ \text{etc}\qquad\right),$$

which is at once recognised as the Fourier expansion of 'unity'

The resultant effect of the series is seen in the distribution of amplitude in the back focal surface of the objective of the microscope, which follows the Fourier graph, Fig 2, in which the amplitude changes suddenly from plus one to minus one at the values of ϕ given by $-\pi/2$, $\pi/2$, $3\pi/2$, etc The sharpness of the transition is determined by the number of terms in the series, in our case by the number of lines in the grating free to transmit light, not by the number which are visibly illuminated

The regions of constant amplitude with their sharp boundaries correspond to the (touching) diffraction 'images', of the condenser pupil formed by the objective, and if the light is unrestricted, the full resolving power, proportional to the number of elements, is thus seen to be valid although only one or two of the central elements are illuminated in any marked relative intensity

I have chosen one of the simplest possible cases to deal with above, but the discussion can be extended to the more general cases of gratings disposed unsymmetrically to the illuminating 'pattern', and hence to gratings with finite apertures In all cases which I have examined so far, the sharply bounded diffraction images appear Therefore the idea underlying the so called critical illumination of the microscopist, that is, that the sharply focused condenser or illuminator destroys the effective coherence relations between the different parts of the object plane, is somewhat fallacious Of course the extension to the practical case involves the illumination by a source of finite area, and an indefinite number of overlapping Airy discs appear in the object plane, so that the discussion of the above type of coherence can often be short circuited (as can be shown in certain cases) in favour of a shortened 'equivalence principle' However, the fundamental features of the optical action in such cases is very generally misunderstood, and many physicists have maintained that the resolving power of the grating would be greatly diminished in such a case as the above in spite of Huygens' principle Whereas the usual 'Abbe theory' contemplates phase relations only between sets of homologous points or lines, the actual process involves phase relations over definite areas The discussion of the consequences of these ideas is outside the scope of a short letter

In order to test these conclusions practically, I have removed the eyepiece of a spectrometer and mounted a piece of process screen with about 200 lines to the

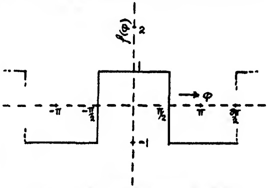


FIG 2 —Fourier expansion of unity (cosine series)

inch in the plane of the spectrum, so that the lines of the grating are parallel to the monochromatic slit image, which is carefully focused in the 'grating' It is not difficult to ensure that not more than one grating element is appreciably illuminated In spite of this the grating is found to produce sharp diffraction images of the aperture of the telescope objective of the instrument An interesting variation is to use the whole spectrum so that every element is apparently illuminated by a different wave length The diffraction, of course, persists

In view of the importance of such considerations in the theory of the microscope, I hope to discuss them more fully elsewhere, and I may add that Mr G F Rose has performed a number of very interesting experiments confirming the principle, which he will also describe

L C MARTIN
Imperial College of Science and Technology,
South Kensington, S W 7, Mar 28

Atmospheric Light Columns from Artificial Lights

THE light columns observed by Mr Currie (NATURE, April 5, p 526), though rather unusual phenomena, have been described previously Once in France and twice in Italy, during the War, I noticed that gun flashes at distances of the order of 15 kilometres appeared as narrow vertical streaks of light centred about 10° 15° above the horizon The occasion in France (Nov 6, 1916) was a most striking one, a note giving the details was published after the War in the *Quar Jour Roy Met Soc*, 45, pp 366 368 (1919) About 9 30 P M on that evening there were visible, in addition, parts of a lunar halo of 22°, a horizontal circle or mock moon ring, and a halo of 90° During the remainder of the evening continual gun flashes produced a weird and unnatural effect as of vertical slits opening and closing suddenly in a dark curtain with a fiery background Later in the same evening a still more remarkable spectacle was presented in that, as a result of enemy action, a large ammunition depot, some 15 km distant from the point where I was stationed, was set on fire The fire (or fires) appeared also as great vertical streaks in the sky, with a dark patch at their centre, the altitude of this dark centre, measured by theodolite, being 32½°

The meteorological situation at the time was that northern France lay under the warm front of an advancing depression, and the sky by this time (11 P M) was overcast with thin alto stratus cloud, deteriorating, through which the moon still shone dimly The optical phenomena produced on this evening by the coincidence of a modern bombardment and a great ammunition fire with the peculiar meteoro logical and optical situation which produces mock moons, etc, have possibly seldom been equalled in history Even in less sensational form, the pheno menon of vertical light columns from artificial lights is apparently seldom seen in western Europe, at least, even knowing of its existence, I have not often seen it

Again, Prof Carl Stormer states (in *Geof Pub*, vol 4, No 7, pp 57 58) that he saw "a singular atmospheric optical phenomenon", near Oslo on Feb 5, 1922, when spectroscopic examination enabled a column of red light to be distinguished as not being an auroral ray It was verified later that in this case the fire had been 6 km distant It is remarked that there was diffuse thin cloud through which one could distinguish the stars, and that this cloud must have consisted of ice crystals and have been at a height of about 3000 metres Prof Störmer told me recently that he has not on any other occasion seen such a phenomenon

A H R GOLDIE

Edinburgh, April 10

MR HUGH NICOL's explanation (NATURE, May 3, p 671) of atmospheric light columns from artificial lights is not merely an extension of mine but an alternative My explanation, the orthodox one, is that the columns are due to the *reflection* of light from laminar crystals, his suggestion is that the columns are due to *diffraction* by laminar or acicular particles

I do not think the diffraction hypothesis can be accepted The laminar crystals which are in the majority when phenomena like sun pillars occur are not microscopic objects The diameters of flat crystals without rays were measured by Dobrowolski He found, for example, that at $-6\ 3°$ C the average diameter was 1 7 mm The cloud particles which pro duce diffraction phenomena, coronæ, are much smaller, having diameters of the order 0 02 mm

The most satisfactory demonstration that reflection does take place from crystals with horizontal surfaces comes from aeronautical observations It some times happens that the aeronaut flying over a cloud sees on the cloud a white patch, the under sun When he comes to a break in the cloud and catches a glimpse of a sheet of calm water below, he realises that the direction of the brightest part of the under sun is just that of the image of the sun in the water

As we are obliged to admit the effectiveness of re flection in this case, there is no need to doubt that the same cause is operative in the other

F J W WHIPPLE

Kew Observatory,
Richmond, Surrey,
May 6

Telosynapsis or Structural Hybridity in *Œnothera*?

IN a recent article[1] I have put forward a hypo thesis which I consider provides an explanation in terms of segmental interchange and parasynapsis of (i) the occurrence of ring formation in *Œnothera*, (ii) its inheritance on selfing and crossing, and (iii) the occurrence of mutant forms differing in properties of ring formation from their parents These seem to be the essential requirements of a working hypothesis expressing the relationship of *Œnothera* with other plants and animals Further, the premises on which the hypothesis is based have been defined very fully in later articles[2 3 4, 5]

Two of Prof Gates's pupils, Miss Sheffield[6] and Mr Catcheside,[7] have defended his earlier views and criticised this hypothesis on general grounds, without, however, providing any evidence that the hypothesis is incompatible with earlier observations Their objections are directed against my first paper and would, I feel, be removed by a study of the theoretical principles enunciated with some precision and a great amount of detail in the later ones[2, 3 4, 5] which they do not quote It seems superfluous to define these principles again, for there is little to add and nothing to take away

Catcheside,[7] however, has also made a new observa tion, namely, that a ring of 21 chromosomes is formed in a triploid plant, this he concludes "com pletely disposes of the hypothesis of segmental inter change, adapted (*sic*) by Darlington as a basis for parasynapsis in *Œnothera*" Mr Catcheside has been good enough to show me his preparations The critical structures seemed to me susceptible of being interpreted, not as a ring of 21 chromosomes, but as consisting of various configurations of the kind observed by Håkanssen in his account of triploid *Œnothera*[8] Thus the associations I made out were the following (i) unpaired chromosomes, (ii) rod pairs, united at one end, (iii) ring pairs, united at both ends, (iv) chains of three and of four chromo somes, (v) branched chains of chromosomes (with triple union), (vi) ring pairs associated (by a triple union) with one end of a third chromosome Mr Catcheside has given a formula, based on my hypo thesis, with which these types agree

In view of the difficulty of interpretation of dia kinesis figures in triploid *Œnothera* (cf Catcheside's figures 35 and 36), I think the novel conclusion that he has arrived at is a little precipitate Earlier workers on triploid *Œnothera* have often hesitated to come to any decisive conclusion with regard to the delicate question of the association of the chromo somes Gates,[9] for example, has contented himself with saying that "the chromosomes are scattered for a considerable distance along the long axis of the spindle", and later[10] that the 21 chromosomes are "somewhat scattered along the spindle as is usual in many Œnotheras" These difficulties led Gates to

conclude[9] "that there is usually no metaphase, strictly speaking"

P S—Since writing the above I have received a paper by two of the leading authorities on this subject in the United States[11] who "have compared the chromosomal phenomena in *Datura* and *Œnothera* and have shown that segmental interchange is a possible basis of circle formation in both genera" Further, these workers have been able to determine the type of configuration that would be shown by a hybrid, from a knowledge of the pairing properties of its parents' chromosomes and the genetical properties of their characters In four cases tested these determinations (one of them a prediction) were shown by observation to be correct

Those who are familiar with the sterile speculations prompted by the theory of telosynapsis will notice a welcome change in the close reasoning now being profitably applied to the chromosome analysis of *Œnothera* C D DARLINGTON

John Innes Horticultural Institution,
Merton Park, London, S W 19,
April 11

1 Darlington C D *J Genet* **20** part 3 1929
2 Darlington C D *J Genet* **21** part 1 1929
3 Darlington C D *J Genet* **21** part 2 1929
4 Gairdner A E and Darlington C D NATURE, **125**, Jan 18 1930
5 Newton, W C F and Darlington C D *J Genet*, **22** part 1
6 Sheffield F M I *Proc Roy Soc* **105** B, 1929
7 Catcheside D G *Trans Roy Soc Edin* **56** part 2, 1930
8 Håkansson, A *Hereditas* **8** 1926
9 Gates, R R *Bot Gaz* **48** 1909
10 Gates R R *Ann Bot* **37** 1923
11 Blakeslee A F and Cleland, R E *Proc Nat Acad Sci* **16** 1930

The Integuments of Whales

IN whales the integuments may be supposed to serve a double or treble purpose the outer layers—the epidermis and the pars papillaris of the dermis or cutis vera protecting the underlying parts, and the deeper—the thick and oily pars reticulata or 'blubber' preventing the loss of heat, and at the same time diminishing the specific gravity of the body and reducing its tendency to sink

In the Greenland whale (? also in the Atlantic whale) the epidermis is thicker than in the 'fin whales', and in the Delphinapteridæ (that is, in the narwhal and white whale) it is thicker, although not to the same extent, than in other 'toothed whales' Moreover in the Greenland whale and in the Delphinapteridæ a pars papillaris which is tough and does not yield oil is present, a condition not met with in the 'fin whales' and in many of the toothed whales'

Are the integuments thicker in the calf than in the adult ? The answer appears to be in the affirmative the epidermis in the young sperm whale is $\frac{3}{8}$ in in thickness against $\frac{1}{8}$ in in the adult, according to Beale, and in the calf of the Greenland whale nearly 2 in against about half that thickness in the adult, according to Scoresby

An epidermis 2 in thick is remarkable, but Scoresby makes the same statement in his "Journal of a Voyage to the Greenland Sea in 1822", and in the log book of his 1811 voyage preserved in the Whitby Museum

In the blue fine whale (*B Sibbaldi*) the blubber is known to be thin and imperfectly formed at birth (see Turner, *Trans Roy Soc Edin*, vol 26) Assuming that this is also the case in the 'right whales', might not the great thickness of the epidermis in the calf of the Greenland whale be a protection against the coldness of the Arctic waters until the blubber has reached its normal character and thickness ?

As mentioned in Buckland's "Notes and Jottings", p 352, and recently by Sir Sidney Harmer (see NATURE, Feb 22, p 286), the 'inner skin' or pars papillaris of the narwhal and white whale were at one time used in making leather, but, so far as I know, the corresponding layer of the skin of the Greenland whale, although tough and $\frac{1}{4}$ in thick, according to Scoresby, was never put to a similar purpose The whalers looked on it as valueless and threw it overboard together with the thick 'black skin' or epidermis attached to it Not so the Eskimo, they held it in high esteem as an article of diet 'Maktuk', the Eskimo name for the rejected part of the whale's integument, is, according to Low ("Cruise of the *Neptune*", p 261), usually eaten boiled "when cooked it has the appearance of thick black indiarubber and is soft and gelatinous while its flavour approaches that of the clam" The corresponding parts of the narwhal and white whale were cooked and eaten in the same way ROBERT W GRAY

8 Hartley Road, Exmouth,
April 21

Search for an Inactive Isotope of the Element 84 (Polonium)

THE elements 81 (thallium), 82 (lead), and 83 (bismuth) have both radioactive and inactive isotopes, whereas the elements 84 92 are only known in an active form Several attempts have been made to find inactive isotopes of the latter elements Aston, using his mass spectrograph, tried to discover a stable isotope of radon in the atmosphere, and Hahn made extensive researches to find an inactive isotope of radium All these attempts failed

We have recently tried to extend the series of inactive elements by searching for an inactive isotope of the element 84 (polonium), which follows bismuth Through the work of the discoverer of this element, Mme Curie, and her co workers, as well as of Marckwald and of many others the chemical properties of polonium were found to be intermediate between those of bismuth and tellurium Hence it is obvious that if a stable isotope exists, it must be associated in Nature with tellurium or bismuth

We looked for the elements 84, therefore, in the following tellurium and bismuth minerals Hessite, calaverite, nagyagite, tetradymite, and bismuth glance as well as native bismuth The minerals were dissolved, and a known amount of polonium added as radioactive indicator On removal of the polonium from the solution, it was to be assumed that any isotope present in the solution would accompany the active polonium By special methods devised for the purpose, it was possible to regain the added polonium electrolytically on molybdenum electrodes, the deposit weighing only about 1/10 mgm X ray investigations, carried out by the secondary ray method to avoid the possible volatilisation of the substance under the action of the cathode rays, have shown that the deposit cannot contain more than 1/2 per mille of the element looked for The X ray line searched for was polonium $L\alpha_1$, the wave length of which was calculated from Moseley's law to be 1111 X U All the lines on the plate could be identified as belonging to lead, bismuth, silver, mercury, or tungsten As we started with about 400 grams of each of the minerals mentioned, 1 gm of each mineral cannot contain more than 10^{-7} gm of the element in question This negative result is in agreement with generalisations arrived at by Dr A S Russell

There is thus very little hope of finding an inactive polonium isotope, or of extending the series of radioactive elements which now exists beyond 83 (bismuth)

G HEVESY
A GUENTHER

Institute of Physical Chemistry in the
University of Freiburg im Breisgau

The Oldest Record of a Slug

MISS ALICE MACKIE, writing from Egypt, sends me a photograph showing a couple of slugs represented on a wall at Karnak (Fig 1) These figures are of course well known to Egyptologists, but probably not to malacologists They appear to represent the species *Veronicella nilotica* (Cockerell, *Nautilus*, January 1910, p 108), which was found by the Nile above Khartoum In my original account I could only give the coloration as shown by alcoholic material Mrs G B

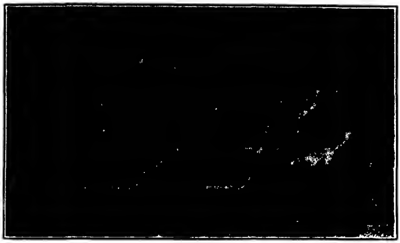


FIG 1

Longstaff found a specimen among papyrus on the river bank at Hillet al Nuwer, an islet on the Bahr el Gebel She noted that the living animal was very dark grey above, beneath dirty yellow turning to deeper yellow anteriorly [1] This agrees sufficiently with the Luxor figures, which are shown to be dark above and pale below As this is the only slug of the kind known from this region the identity is reasonably certain

T D A COCKERELL

University of Colorado, Boulder,
Colorado, Mar 30

[1] Robson *Journal Linnean Soc* Zoology 32 p 268 1914

Polarisierte und gerichtete Röntgenstrahlung aus einem Kristall

DURCH mehrere experimentelle Untersuchungen habe ich festgestellt, dass die Atome der Elemente Wasserstoff und Helium eine ausgezeichnete Achse besitzen, in Bezug auf welche die Gleichgewichtslagen ihrer Elektronen angeordnet sind Auf Grund spektraler Analogie kann man folgern, dass auch bei den schweren Elementen die Elektronen an der Atomoberfläche in Bezug auf eine ausgezeichnete Achse angeordnet sind

Analog sind im Innern und auf dem Grunde der Elektronenhulle der schweren Atome die Elektronen in Bezug auf eine ausgezeichnete Achse angeordnet Dies lässt sich aus einer Erscheinung folgern, welche ich kurzlich aufgefunden habe, es ist die Erscheinung der Polarisation und der gerichteten Intensitätsverteilung der K Strahlung eines Elements aus einem Kristall Die sekundäre K Strahlung des Brom Atoms, welche infolge der Absorption primärer Röntgenstrahlung von monoklinen γ, γ Dibromanthrazenkristallen emittiert wird, zeigt namlich folgende Eigenschaften in Bezug auf die Achse, welche senkrecht zur Symmetrieebene steht, ist in einer Richtung, welche senkrecht auf dieser Achse steht, die Intensitat der sekundaren K Strahlung der Bromatome des Kristalls grosser als in einer Richtung von kleinem Winkel gegen jene Achse, ausserdem ist diese Strahlung der Bromatome zum Teil in der Weise polarisiert, dass die Intensitat der elektrisch parallel jener Achse schwingenden Strahlung bis zu 20 per cent grosser als die Intensität der senkrecht dazu schwingenden Strahlung ist

Aus diesen Eigenschaften der K Strahlung der Bromatome aus Dibromanthrazen lassen sich folgende Schlusse ziehen 1 die Achsen der chemischen Molekule in dem Dibromanthrazenkristall liegen parallel zu einander, 2 die Valenzachsen der Bromatome in diesem Kristall sind einander parallel, 3 die Elektronen der untersten und der nachsthöheren Schale des Bromatoms, welchen die K Strahlung zugeordnet ist, besitzen in Bezug auf eine ausgezeichnete Achse bestimmte Lagen

Ein ausfuhrlicher Bericht uber die vorstehende Untersuchung wird voraussichtlich in den *Annalen der Physik* erscheinen

J STARK

Grosshesselohe Munchen,
April 15

The Ancestry of Man

THE theory I have been advancing during the last two years that man is not descended from the apes, but from a primitive common anthropoid stock which gave rise to the apes as well as to our own direct ancestors, has gradually come about from the intensive study of fossil man the world over as well as from our recent and more extended knowledge of the anatomy and the habits of the apes This new knowledge reveals data entirely unknown to Darwin, and he to day would be among the first to grasp the new outlook and give it his unbiased consideration I regret to find that advanced and entirely unauthorised reports of my presidential address before the American Association for the Advancement of Science at Des Moines were interpreted as disloyal to Darwin s theory of the descent of man More extended knowledge of the data on which the new point of view is founded will cause such criticism to subside, as disloyalty to the main features of Darwin s theory of the descent of man is unthinkable

It seems that in human palæontology new ideas of time and space, as well as of heredity and of the principles of descent or phylogeny, are compelling us to recast or reconsider all the older ideas to which we fell heir at the close of the nineteenth century I regret that pressure of other work compels me to postpone the assembling of fresh facts and the meeting of many of the arguments which are now being advanced by several authorities for the older point of view Like all other questions of descent, the problem of human ancestry can only be settled by fresh palæontological discovery In view of the fact that anthropoid ape remains are very rare and that primitive human remains are still more rare, we may have to wait for several decades before the fortunate discovery is made The ancestors of man were the most clever of all animals and, therefore, the first to avoid natural burial and fossilisation

HENRY FAIRFIELD OSBORN

Osborn Research Rooms,
American Museum of Natural History,
April 7

Scattering of X-rays by bound Electrons

IN 1923, Compton gave a theory with experimental verifications of scattering of hard X rays by free electrons, and in a subsequent paper he considered theoretically the case of modification of radiation scattered by bound electrons (Compton "X rays and Electrons", p 286) in which the latter may be removed from one orbit to the other Recently, I have observed that a part of the monochromatic X rays in passing through carbon undergoes a change in frequency and appears on the longer wave length side of the primary radiation Copper $K\alpha$ radiation was allowed to pass through carbon soot and the transmitted radiation was analysed by a calcite crystal fitted up in a Siegbahn spectrograph A current of 8 m a was passed through the X ray tube at a peak voltage of 28 k v In addition to the original copper $K\alpha$ radiations and other lines in the tungsten L series, a new diffuse broad line of wave length 1592 X U ($\nu/R = 572$) appeared on the photographic plate This new line appears to have a more or less sharp edge on the short wave length side The wave length of this line was compared with those of other lines the presence of which might be expected from the X ray tube excited under the given condition and was found not to coincide with any one of them The time of exposure was varied from 8 to 14 hours in different cases and all of them showed the same effect

The origin of this line may be explained by the fact that the copper $K\alpha$ radiation in passing through carbon loses a part of its energy equal to that of removing the electron from the K shell either to the optical level or to infinity The frequency difference between this line and the original copper $K\alpha$ lines is 20 1 (in ν/R) whereas the value of carbon $K\alpha$ is 20 4 (in ν/R Soderman, *Zeit f Phys*, 52)

It may be mentioned here that the possibility of this type of radiation was also predicted by Kramers and Heisenberg, and it shows a certain similarity with the Raman effect in molecules

Nickel $K\alpha$ radiation produces a similar effect on passing through carbon Further, this effect has also been observed in the case of oxygen and nitrogen for copper $K\alpha$, nickel $K\alpha$, nickel $K\beta_1$, tungsten $L\alpha_1$ radiations, the measurements of which with photographs will be published in due course B B RAY

University College of Science,
92 Upper Circular Road, Calcutta,
April 8

The Identity of Colloidal Particles in Soap Sols and Gels

DR M E LAING MCBAIN and Prof J W McBain found about ten years ago that several properties, for example, the conductivity, lowering of vapour pressure, concentration of sodium ion, etc, of the sols and gels of sodium oleate are identical, and from this they came to the conclusion that the colloidal particles in the two states are identical in nature and amount

It is well known that light scattering gives us an accurate idea of the delicate changes in the colloidal particles in sols and gels, and is therefore a very significant property of colloids During my investigations on the scattering of light in soap sols and gels I found that the intensity of the light scattered by gels of sodium oleate is distinctly greater than that in sols at the same temperature (NATURE, Nov 2, 1929, p 690) In a recent letter to NATURE (Jan 25, 1930, p 125) Dr M E Laing McBain and J W McBain report that they have succeeded in preparing samples of the same solution of sodium oleate, some of which were fluid sols and others typical jellies, but the light scattering of which was identical within the limits of experimental error They further suggest that the enhanced intensity of the scattered light in the gels observed by me might be due to a partial curding or crystallising out

It may be permissible to point out here that J W McBain appears to have previously observed a slightly enhanced opalescence during the formation of gels from soap solutions (cf McBain's article in J Alexander's "Colloid Chemistry", vol 1, p 140), though the other properties, such as electrical conductivity and lowering of vapour pressure, remain unaffected K KRISHNAMURTI

Sir William Ramsay Chemical Laboratories,
University College,
London, W C 1

Intensities in Band Spectra

PROF E CONDON (*Phys Rev* 32, p 858, 1928) has shown that on the basis of the new quantum mechanics, certain nuclear transitions associated with electronic transitions are more probable than others The actual intensities of the lines emitted depend upon the integral of the electric moment and the wave functions of the initial and of the final states The evaluation of this integral can be approximately carried through for symmetrical diatomic molecules The intensities of the lines associated with vibrational electronic transitions may therefore be calculated and expressed in terms of the change in separation of the nuclei during the transition

The intensities calculated by this method agree very well with experiment especially in the case of the alkali molecules The calculated intensities for Na_2 and K_2 at the positions (1 2) and (2 1) in the band spectra double entry table for intensities are very small, thus being in good agreement with the experimental intensities given by Fredrickson and Watson (*Phys Rev*, 30, p 429, 1927) The occurence of a large number of transitions between high quantum states for iodine is also explained There are certain regular deviations from experiment in the case of hydrogen that have not as yet been explained The complete calculations will be published in the *Physical Review* ELMER HUTCHISSON

Berlin, Friedenau,
April 17

The New Planet

I SEE that, in the notice which appeared in NATURE announcing the discovery of the new planet, it was suggested that the object might represent the outermost member of the family of planets formed from a portion of the sun drawn out by the attraction of the star the approach of which caused the catastrophic formation of the planetary system, or, as it was put—the new planet might be formed from the tip of Sir James Jeans' cigar Since then the further particulars of the orbit appear to indicate that it is cometary in character, being eccentric and inclined at a considerable angle to the ecliptic These two divergencies from the characteristics of the previously known planets, coupled with its great distance, would appear to be better explained by the theory of capture At least, it may be said that the capture theory deserves consideration If capture is possible, the new planet might be regarded as the first of a new series Further, if the capture theory were actually established, by implication it would be probable that the majority of the stars have captured planets

G F DANIELL

Maidstone, April 25

Angler-Fishes *

By Dr C TATE REGAN, F R S

THE fins of fishes are formed of a membrane supported by rays, which are generally flexible and jointed But in one great group of fishes—the perch group—some of the fin rays, and particularly the front rays of the fin on the back, are converted into strong, sharply pointed spines, weapons of attack and defence It might be thought that these specialised structures would be end products of evolution, but that is not so, for in various offshoots of the perch tribe the spines are modified for other purposes In the flat fishes, which swim by undulating movements of the body and the long marginal fins, the spines are reconverted into articulated rays—an example of reversible evolution In the sucker-fishes, which attach themselves to sharks, turtles, and other marine animals, the spinous dorsal fin is transformed into a laminated adhesive disc placed on top of the head In the angler fishes the spinous rays of the dorsal fin have become slender and flexible, and the first is placed on the head, and forms a line and bait

The angler fish found in British seas has a large flat head, and a wide mouth furnished with sharp depressible teeth The bait is a flap of skin—sometimes white in colour—placed at the end of the line, near the mouth The angler lies on the bottom—and waves about the bait, which is perhaps better termed a lure, for it is not meant to be seized—and so entices other fishes near enough to be caught

In the seas of other parts of the world there are other anglers more or less similar to ours In some of these, as in *Lophiomus naresii* from New Guinea, the skinny flaps that look like weeds, and help to conceal the lurking fish, are much more developed than in the British species

Another group of anglers includes a number of small fishes, compressed in form, and often brightly coloured and marked with patterns of stripes or spots They are found in warm seas, many inhabiting the crevices of coral reefs One lives among the *Sargassum* weed, where its coloration of mottled brown on yellow renders it inconspicuous

The two groups of anglers so far described include fishes that live in the light, they have a coloration that harmonises with the ground on which they lie, or the rocks and weeds amongst which they rest, and their lure is a flap or a tassel at the end of the line A third group includes the anglers that live out in the ocean, and deep down in the dark, generally from about 100 fathoms to 500 fathoms below the surface, not at the bottom, but in mid-water These are uniformly coloured, generally blackish Their lure is luminous, the swelling at the end containing a glandular sac with a luminous secretion, the sac is partly enclosed in a pigmented cup, lined inside by a peculiar membrane that acts as a reflector, the light shines out through the mouth of the cup, and there is some evidence that it can be turned on or off at will Generally the mouth is large, and the teeth are strong, sharp, and depressible inwards

Another peculiarity of the oceanic anglers is the extraordinary distensibility of the stomach In the depths of the ocean meals are scarce, and the angler does not want to refuse one because it is too big There are several examples known of anglers that have swallowed fishes two or three times their own length and several times their own weight, two of these had just begun to digest the fish they had swallowed, and then took baits and were hooked and caught on lines! Others have been carried upwards by the struggles of their victims when these were first seized, and have been found at the surface of the ocean, alive but helpless I believe that these could not have escaped their fate, for their teeth are so arranged that they hold the victim that is struggling to escape, but lie down and allow a little more of it to pass inside every time its efforts relax, so that eventually it is completely engulfed, and makes a considerable alteration to the figure of its captor

In *Linophryne* the teeth are stronger than in any other angler In *L arborifer* the large luminous lure is carried by a short stout line, and below the chin is a large branched barbel, or beard The use of this appendage is unknown, it may be luminous, or the little swellings on the terminal branches may be sensory organs, perhaps giving warning of the approach of other fishes In other species of *Linophryne* the beard is different in structure, and the lure may have a series of filaments on each side of the bulb

Edriolychnus has the skin translucent, although the stomach is pigmented, the luminous organ is sessile, without any line *Gigantactis* is remarkable for the long fine line, in one species four times as long as the fish itself One is reminded of a fly fisherman The movements of the small lure may imitate the swimming movements of a small luminous animal

The line is a fin ray, and like other fin-rays is articulated to the end of a basal bone, this lies in a hollow on top of the head, but in *Gigantactis* its end projects In *Dolopichthys* the basal bone projects more distinctly, and in some other anglers the whole of it may be permanently protruded, and it may increase in length, forming a rod

Lasiognathus (Fig 1) is a complete angler, for it has not only a rod and a line, but also a triangle of hooks, like those used by a pike fisherman In this extraordinary fish the upper jaw is connected to the head by a membrane, the prey, perhaps brought to the mouth by the hooks, must be completely enclosed by a downward movement of the upper jaw, when the membrane connecting it to the head forms the sides of a pouch, the teeth are bristle like, of no use for piercing, but meeting across and closing the gap in front of the lower jaw,

* Friday evening discourse delivered at the Royal Institution on Mar 7

when the prey is inside the mouth I suspect that this fish may feed on Pteropods, which are small enough to be taken in whole, and would offer a good hold for the hooks

There is a considerable diversity among the anglers of the ocean The lure differs greatly in size and form, and may be sessile on the head, or

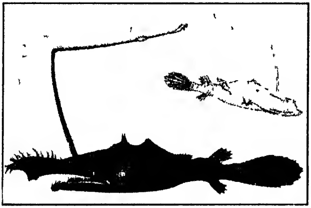


FIG 1—*Lasiognathus saccostoma* Natural size *

at the end of a short or a long line, and the line may or may not be connected with a rod, one fish even has hooks, as well as a rod and line We can get some idea of the meaning of this diversity if we reflect that human anglers specialise, there are salmon fishermen, trout fishermen, pike fisher men, and roach fishermen, each using a different sort of rod, line, and bait or lure Moreover, human anglers may use a variety of baits for the same fish, the trout fisherman, for example, may use artificial flies, spinning minnows, or worms, not to mention other methods It would also be of advantage to the anglor fishes to display a variety of lures, for if all fished with the same bait, in the same way, the inhabitants of the ocean might come to look upon it as a danger signal

The typical members of the group have a uni form coloration, a luminous lure, a large mouth, strong teeth, and a very distensible abdomen This is an example of correlated adaptations, these characters are related to the habits and con ditions of life of these fishes, and can scarcely have been evolved by accident, which is a modern theory of evolution that has some popularity

Further correlated adaptations have developed within the group In *Himantolophus* the lure is very complicated in structure, with numerous tentacles, ending in luminous tips In young examples of this genus, about 2 inches long, the lure is simpler, and the mouth smaller, than in the adult At a still earlier stage, as in all these anglers, there is no line or lure, it grows out from the head These young fishes, with relatively small mouth and feeble teeth, and with the lure absent or little developed, live nearer the surface than the adults, and feed on minute organisms But some retain these juvenile habits throughout life, they never grow to more than two inches long, and the line and lure do not develop *Lipactis* is very similar in structure to a young *Himantolophus*, but has no lure, somewhat larger eyes, and much larger nostrils, indicating that it seeks its food by smell and sight The species of *Rhynchoceratias* differ in their pincer like jaws, and some by still larger nostrils The final stage in this series—*Aceratias*—differs from *Rhynchoceratias* in having the eyes directed forwards (Fig 2), and the snout is shortened in relation to stereoscopic vision, as in man This little fish differs consider ably from the typical anglers of the ocean, but its modifications of structure are all related to the adoption of a new habit, search for food by smell and sight

Neoceratias (Fig 2) is probably related to *Gigantactis*, it has also lost the line and lure and developed the olfactory organ, but on a different plan, one nostril being at the end of a tube This curious fish has teeth outside its mouth, on the surface of the head, each is long, slender, hooked at the end, and inserted in a muscular papilla, so that it is independently moveable One may imagine the ends of two or three teeth coming together to catch something, and then passing it on to the other teeth, until it gets inside the mouth

Now comes the most remarkable thing of all All these free swimming oceanic angler fishes, black and mostly rather terrible in appearance, are females The only males of this group known are

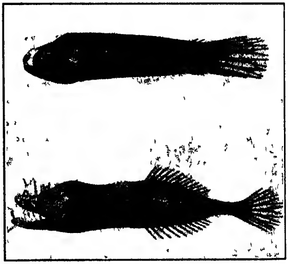


FIG 2—Above, *Aceratias macrorhinus* (× 2), below, *Neoceratias spinifer* (× 3)

dwarfs parasitic on the females A pair of fishes was taken in a trawl to the south of Iceland, they belong to a genus—*Ceratias*—distinguished by the spiny skin, and by the very long rod and short line The wife is 40 inches long, her husband is only 4 inches long, so that she is a thousand times his weight He is attached to her in the mid ventral line The male (Fig 3) has a general similarity to the female, but he has no line and bait, and no teeth He is attached to her by

* The figures are taken from two sets of picture postcards issued by the British Museum (Natural History), entitled 'Oceanic Angler fishes', and sold at 6d a set of five cards, with leaflet

means of outgrowths in front of the snout and of the lower jaw, which meet in front of the mouth and unite with a prominence on the skin of the female The union is so complete that it is difficult to say where one fish begins and the other ends, the connecting tissue is fibrous and full of blood vessels, the general direction of which is from one fish to the other, and the male is a mere appendage, nourished by the continuity of his blood system with that of the female He is quite incapable of feeding himself, for his mouth is closed in front and has no teeth, and his digestive system is reduced to a vestige But he has a heart, and gills, so that he is able to breathe, water for respiration enters through the mouth Another large female *Ceratias* was so fortunate as to possess two males, attached close together on the side of her abdomen arrangement, which has the advantage that the mouth has more room for the intake of water for respiration

These fishes are unique amongst backboned animals in having dwarfed and parasitic males, and unique among all animals in their method of parasitism, for in no other animal is there a union of the blood systems of host and parasite The nearest approach is the embryo of the placental mammals, where also parasite and host are of the same species

Now if we consider the habits and conditions of life of these fishes we can understand the evolution of the dwarfed and parasitic males The oceanic anglers are feeble swimmers, they float about waiting for their prey, and they are necessarily few in numbers as compared with the more active fishes that they attract with their luminous lure

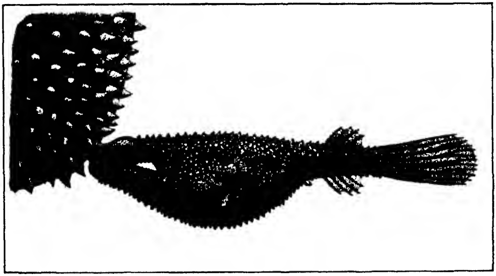


FIG 3 —*Ceratias holboelli* (male) Natural size

In these fishes the eggs are shed in the sea, and the males must be free when they are first hatched, and attach themselves if they find a female, first holding on by the mouth, and then becoming grown to her

In *Photocorynus* a female three inches long has a male only $\frac{1}{8}$ of an inch long attached to the top of her head above the right eye In *Edriolychnus* a female about 3 inches long has a fully adult male, $\frac{3}{8}$ of an inch long, attached under the spine of the præoperculum, and upside down The attachment of the male *Photocorynus* is of the same type as in *Ceratias*, by means of outgrowths in front of the snout and the lower jaw, whereas in *Edriolychnus* the main attachment is inside the mouth, which is choked up In both we must suppose that the male first nipped a piece of the skin of the female between his jaws, and that the ends of the lips fused with the papilla so formed Then if the tongue pressed against and fused with this papilla inside the mouth, the *Edriolychnus* arrangement would result, but if it were pushed forward between the branches of the lower jaw to effect a union with the female below the mouth, subsequent growth would give the other They live a solitary life, and they are in the dark Imagine such a fish, out in the middle of the Atlantic, perhaps half a mile below the surface, How could it find a mate ? But there may be thousands of males in a brood, hatched out at the same time from the eggs shed by a single female, and if these at once look for females, the chances of finding one are much greater than if they waited until later, when their numbers had diminished If they are lucky enough to find one they unite with her and develop at her expense, if not, presumably they perish

These extraordinary habits of the males have led to the degeneration of the organs they no longer need—the lure, the teeth, and the digestive system

The males of these oceanic angler-fishes are another example of correlated adaptations, of several independent changes of structure related to new habits These cannot be explained by the theory of evolution by accident—of changes of structure being due to changes in the germ-cells, that have no relation to habits and environment They fit in better with the theory that the actions and reactions of the animals themselves result in modifications of structure that become hereditary

The Geological History of the Pacific Ocean *

By Prof J W GREGORY, F R S

THE Pacific Ocean, as the greatest geographical unit on earth, with an area greater than that of all the land, presents the difficulties as well as the attraction of its size Its broad trigonal shape, nearly 10,000 miles wide from New Guinea to Peru, forms a striking contrast to the relatively narrow trough of the Atlantic, and the differences in size and shape render the recurrence of the same structural and biological units, which is so conspicuous with the opposite coasts of the Atlantic, less likely with the Pacific Its 3000 islands give little evidence as to its geological history, for most of them are composed of comparatively young volcanic ejecta or coral rock

The first striking feature of the Pacific is its apparent unity Its surrounding lines of volcanoes, the so called 'girdle of fire', its unstable marginal earthquake zone, the parallelism of its bordering mountain chains to its shores, the features which led Suess to describe its coasts as so different from those of the rest of the world as to constitute the Pacific Coast type, and the association by Prior and Harker with this type of a special suite of rocks, have all supported the conclusion that the Pacific Ocean has a geographic and geological unity which indicates its permanence throughout geological time This view, urged by Dana in 1846, has been adopted by many geologists, such as Russell Wallace, and palæontologists such as W D Matthew, and is supported by the recent verdict (1929) by Professor Schmidt of the Zoological Museum, Leningrad, that "The Pacific was formed in very ancient times and has undergone no important changes"

This belief in the permanence of the Pacific has been rejected by many authorities The existence of a Pacific continent was advocated in his presidential address to the Geological Society sixty years ago, by Huxley That the Pacific is the oldest ocean is accepted by some authorities, as von Huene, who reject its permanence In 1899, however, I argued against the Pacific Ocean having been permanent, and expressed the view that "the Pacific Ocean may have undergone great changes later than the other oceans" To that opinion I still adhere

Faith in the unity of the Pacific was strengthened by widely accepted theories of its origin The view that the Pacific Basin is the hollow left when the moon was torn away from the earth is untenable, as the moon is 37 times too big and 20 per cent too heavy The standard geological theory of the origin of the Pacific is that of Suess, who inferred from the parallelism of the surrounding mountains its unity of origin and from the marine Triassic rocks on the coasts its Triassic age

That the margins of the Pacific have been greatly altered is certain All authorities on the geology of the East Indies agree that they are fragments of a continuous land, which lasted throughout the Palæozoic and extended far into the Pacific This ancient Malaysia was continued northward as the Cathaysia of Grabau by which China extended eastward into the Ocean Australia, it is generally accepted, was once continued eastward to Fiji and New Zealand, while Asia extended, south of Japan, to the line of the Liu Kiu and Ladrone Islands

On the American side the former occupation of the eastern Pacific by land—the Schuchertland and Burckhardtland of von Ihering—is necessary to explain the stratigraphy of western America, the coarse conglomerates in Chile, and the sudden truncation of the structural grain of South America in Peru and in Ecuador near Paita

On the northern side the Pacific was once occupied by the land bridge from Mongolia to the United States, south of the Bering Sea, which was used in four different epochs by large quadrupeds To the south the replacement of sea by land is affirmed by all those who believe in the connexion of Australia and New Zealand to South America either directly or by Antarctica

A marginal reduction of the Pacific is, however, not enough, for many botanists, zoologists, and palæontologists, from very different lines of evidence, insist that the range of plants and animals, living and extinct, requires the existence of extensive lands in the Central Pacific, and probably of land lines nearly or wholly Trans Pacific, such as the Archigalenis of von Ihering

Such striking coincidences in structure as occur on the opposite sides of the Atlantic are not to be expected with the Pacific, and it may be impossible to disprove that the community of organisms in America and Asia is not due to passage across the Bering Sea but in many cases that route is improbable, as it was not in existence at the time required, or was too far north to be in a suitable zone of latitude Many zoologists claim that the chief Pacific islands have been peopled either by inhabitants who developed in the Central Pacific or reached the islands there by migration across a land connecting them with the continent to the south west that occupied Polynesia

The geological evidence is fully consistent with this conclusion It indicates not a persistent Pacific Ocean, but the occupation of its site by a succession of narrow seas separated by land and with a predominant trend west and east Thus in the Lower Cambrian the Olenellus Sea to the north was separated from the Redlichia Sea to the south west, in the Middle Cambrian one sea spread from the Himalaya to the Rocky Mountains, and an arm of it, in the Upper Cambrian, overspread eastern Australia The whole of the southern Pacific from New Zealand to South America may have been land, for the only Cambrian in South America was an arm of the Atlantic

The Ordovician in Pupiao in southern China

* Presidential address to the Geological Society of London on Feb 21

has "scarcely any trace of an American element", the fauna there is European China and western America had no direct marine connexion

In the Devonian the East Indies and the China Sea were occupied by a land that extended into the western Pacific and bounded the sea by which the European fauna reached south eastern China and Tongking In the Middle Devonian the sea with the Flabellites fauna lay along western South America and in the valleys of the Amazon and Mississippi, but it did not reach Australia, where, in the Upper Devonian, the Chemung fauna of New York invaded New South Wales the absence of this fauna from Asia and California shows the separation of the north western and south eastern Pacific seas

The Carboniferous had the same separation of the Asiatic and West American marine faunas and evidence of land is given by *Gigantopteris*, a member of the Gondwana flora, which is found in southern and eastern China and in Texas, and doubtless entered both from a Pacific land

The Trias has a wide range around parts of the Pacific, but was deposited in separated seas—an Arctic Ocean with a gulf to British Columbia the western end of a southern European sea which reached Venezuela and South California, the eastern end of the same sea extended past the Himalaya to New Zealand It is represented in New Zealand by a distinct province which was in a gulf and was not the opening to a Pacific Ocean Evidence of trans Pacific lands in the Trias is given, according to von Huene, by the affinities of the Triassic reptiles of South America to those of India

The Jurassic was the time of the main development of the Pacific continent of Haug The Liassic sea of the North Pacific was separated from the contemporary seas in Central and South America The Malm fauna of Chile ranged westward to the Himalaya, but was different from that of the North Pacific and the European fauna in the Antillean region The Pacific region in the Upper Jurassic according to Uhlig was occupied by faunas of four geographical provinces

In the Cretaceous shallow water connected California and India, while later a land separated the Senonian faunas of California and Japan from that of Chile and New Zealand The North Pacific was crossed by the giant Sauropods in their range between Mongolia and Montana, and a land route in a suitable latitude was used twice later by large quadrupeds The South Pacific was crossed in the Cretaceous by reptiles, that migrated between South America and Asia, as the route via North and Central America was not then available Lands west of America allowed the diffusion of the Dakota flora (Turonian) southward to the Argentine

In the Kainozoic Era the trans Pacific lands seem to have lasted until the Oligocene or early Miocene, since the alligator, various reptiles, amphibia, insects, crayfish, land mollusca, primitive mammals, etc, indicate migration routes across the tropical and warm temperate zones Land plants do the same, for Asa Gray showed that the floras of China and the southern humid areas of the United States have much in common *Gordonia*, one of the plants found in both areas, helps to fix the date of the migration, as it has been recently discovered by Berry in the Miocene of the Rocky Mountains

The occurrence of similar animals and plants on opposite sides of the southern oceans has been explained by their origin in a northern land or their independent evolution The northern monopoly of evolution is opposed by the theory of Ernst Schwarz of the southern origin of the mammals, and the evidence of the development of various animals, including some freshwater fish (vide Regan) and many plants in the southern land The evidence of parasitology renders the alternatives to the spread of some animals across the southern Pacific, according to Launcelot Harrison, "merely grotesque"

The life of the Pacific islands, according to many authorities, can only be explained by the existence of extensive Pacific lands on which developed a Eu Pacific fauna and flora These lands must have been connected with Polynesia and Australasia, and were probably united to the former extension of the Andes to the north west of Peru, according to Steinmann his Chimu andes extended to Hawaii and Polynesia, and were cut off from South America at the end of the Eocene

Lands survived across the Central Pacific apparently until the Lower Kainozoic, but as the higher mammals and birds characteristic of the Upper Kainozoic are distinct on opposite sides of the Pacific, the land bridges were destroyed before these animals could use them

Darwin's theory of coral islands—now established by the boring at Funafuti, gravity observations on Jaluit, the widespread presence of mid Kainozoic foraminiferal limestones, the drowned nature of the coasts of many of the islands, and the botanical evidence from the Marquesas of their subsidence for thousands of feet—implies the sinking of a belt across the Southern Pacific during the Upper Kainozoic

The evidence of the sedimentary rocks that the crust subsides to amounts up to 50,000 feet is opposed to the extreme form of isostasy, which denies the possible uplift of an ocean floor The arguments in favour of that view, based on a sub oceanic heavy stratum, as proved by the distribution of igneous rocks, gravity observations, and the speed of earthquake waves, rest on such doubtful assumptions that geologists should be guided by the direct geological evidence

The long Altaid and Alpine mountains were doubtless continued across the Atlantic and the Pacific by at least raised belts The ending of the Altaid line in the south eastern part of the main island of Japan, and of the Alpine lines in southern China and the East Indies indicate their former extension into the Pacific Its floor must have been disturbed by the forces that crumpled strips across the whole length of Eurasia into fold mountain chains, by the mutual pressure between the northern dome of the world and the protuberant tropical belt

News and Views

Congratulations and good wishes are offered to Dr George Claridge Druce, who will be eighty years of age on May 23. The story of his earlier years has been told by Dr Druce himself in the introduction to the "Flora of Buckinghamshire" (1926), the third of his series of floras descriptive of the Thames valley counties. The autobiography tells of difficulties successfully overcome by hard work and perseverance, and is an interesting record of the zeal and industry with which from early boyhood Dr Druce has, almost literally, pursued the study of our British flora, and has gained a knowledge of the rarer plants in their native habitats which is unique. This has been achieved in the intervals of an exacting business life—that of a pharmaceutical chemist. For many years Dr Druce has been honorary curator of the Fielding Herbarium at Oxford, and, in association with a former professor, Dr S. H. Vines, has published accounts of the historic collections at the University, notably the Dillenian and Morrisonian herbaria. The field botanist is indebted to him for a modern edition of the best used handbook on British plants—Hayward's "Botanist's Pocket Book"—and Dr Druce has also himself compiled a "List of British Plants."

Since 1904, Dr Druce has been the moving spirit of the Botanical Exchange Club, the annual report of which supplies records and critical notes on members of the British flora. In 1908 its circle of interest was extended by the formation of a society which should include well wishers in addition to active workers. Dr Druce's botanical interests are not limited to the British flora. He has travelled widely, his visits extending so far as Australia and South America. Our latest news of him was that he was botanising in Cyprus, an account of a former visit to which he recently described at a meeting of the Linnean Society. That Dr Druce should have received an honorary M.A. degree and later the Sc.D. of Oxford is evidence of the esteem in which his work is held and the position he has won in the University town in which he has for many years lived and worked. A further recognition was the fellowship of the Royal Society, to which he was elected in 1927.

It is now well known that certain forms of vomiting are primarily caused by depletion of the body's store of carbohydrate; in such conditions the administration of an easily assimilable sugar is an important part of the treatment. All carbohydrates are absorbed after digestion as monosaccharides and ultimately converted into glucose or glycogen; hence for quickest absorption without the need for preliminary digestion glucose is indicated. It is useful in the prevention of cyclical vomiting in children, as a source of food in starvation during illness, in the cure of insulin hypoglycæmia, and has been recommended in surgical shock, chloroform poisoning, and asthma. The vomiting of sea sickness is frequently preceded by acidosis; the administration of glucose may prevent it, or may abolish it if it has already occurred. There is evidence that certain toxic agents exert a less deleterious action on the liver when that organ contains a good store of glycogen; glucose is the simplest form of carbohydrate to administer to ensure rapid filling of this store. Pure medicinal glucose can be obtained in the form of a white powder from Messrs. The British Drug Houses, Ltd., London, N.1; for the preparation of a sterile solution suitable for subcutaneous, intravenous, or rectal injection, it is also issued in a concentrated sterilised solution in sealed tubes.

The earthquake of May 5, which was recorded at Kew Observatory at 13 hr. 58 min. 11 sec. G.M.T., was the strongest, indeed the only great destructive earthquake, ever felt in the south of Burma. The centre seems to have been near Pegu, the ancient capital of the country. Of this city of 14,000 inhabitants, the greater part is destroyed, the pagoda, the municipal offices and the main street being in ruins. After the earthquake, a fire broke out in the most congested quarter of the town and an area of about two square miles was swept by the flames. As in San Francisco, Tokyo, and Yokohama, they spread unchecked owing to the destruction of the water mains. The number of persons killed in Pegu is estimated roughly at from 600 to 1000, not an excessive number seeing that the earthquake occurred at night. At Rangoon, about 45 miles to the south-south-east of Pegu, 46 deaths are reported, while many buildings are seriously injured. The total number of shocks felt in Rangoon up to 1904 is given by Montessus de Ballore as only five, of which one in 1888 was strong enough to throw down a few chimneys, and another, 1894, to unroof or shatter some, but not many, houses. Farther to the north, in the district surrounding Amarapoora and Ava, shocks are much more frequent, while that which occurred on Mar. 23, 1839, must be reckoned as one of the world's great earthquakes. It may be of interest to add that the burned out areas of Tokyo and Yokohama in 1923 contained about 7 square miles and 3 square miles respectively, while that covered by the great fire of London in 1666 was not more than two thirds of a square mile.

In 1898 the British Association met in Bristol, and in the following year a University College Colston Society was formed, on the lines of the Colston societies already in existence commemorating the work of Edward Colston, but for the express purpose of supporting University College, Bristol. After various slight changes of title, the society still exists as the Colston Research Society, a unique association of citizens for the promotion and assistance of research in the university of their city. A brief history of the Society and record of its work has been prepared by Dr Morris W. Travers. For a number of years the Society's activities took the form of an annual appeal in the president's name, as a result of which about £500 a year was handed over to the Council of University College, Bristol. In 1908 a part of the Society's

funds was diverted to the promotion of the scheme for a University of Bristol, and with its foundation the Society used its funds to finance research in the University An experiment in the form of industrial research fellowships was inaugurated in 1922, and six industrial firms each agreed to subscribe £150 for the support of as many research fellowships for one year, the donor having the right to choose the line of research adopted The scheme proved difficult to work in the University laboratories and has not been repeated In 1927 it was announced that a fellowship had been established in connexion with cardiac research being carried on in the University, thus reverting to one of the original aims of the Society Last year the Society received a sum of £5000 from Mr R H Mardon to form a trust fund for the endowment of research, and Mr Mardon also made himself responsible for the additional charges for incorporation of the Society which his gift necessitated The citizens of Bristol can look back on their steady support of research and higher education with pride and satisfaction, and it may be hoped that their Colston Research Society will be copied in other university cities of Great Britain

THE thirty sixth James Forrest Lecture of the Institution of Civil Engineers was delivered on May 5 by Prof R V Southwell, who took as the subject of his address—"Aeronautical Progress, 1914 to 1930" This was the first opportunity the Institution has had for viewing in perspective the extraordinary advances which have been made in aerial locomotion since the period prior to the War, and was all the more apt since the last lecture dealing with the subject was given by Dr Lanchester in May 1914, to an audience ignorant of what the future held in store for it Prof Southwell stressed the remarkable fact that the kernel of all we yet know of fundamental aerodynamic theory was to be read in the 1914 lecture by such as could understand Dr Lanchester had been at great pains to give estimates of the gains that might be expected to accrue from improved design in speed, range, etc, and while his forecast of the rate of future progress has naturally been surpassed by actual achievement under the accelerating influence of the War, Prof Southwell insisted that he could find no direction in which he underrated what was practicable, with the possible exception of the internal combustion engine This view was supported by a brief summary of the progress made during the last sixteen years Turning to some theoretical aspects of the subject, Prof Southwell praised the influence which the Advisory Committee for Aeronautics has exerted both on the industry and in the direction of scientific research under the guiding wisdom of Sir Richard Glazebrook It seems remarkable that this new wing should have so organised itself as to provide a continuous channel between pure scientific research and its direct application to industry when so many fields of industrial development of much older date have not yet succeeded in establishing anything like this continuity The remaining part of Prof Southwell's lecture was taken up with a critical scrutiny of the more modern developments on the theoretical side, stressing in conclusion that there are many lessons to be learned by older branches of engineering from the newer progress, by those who are prepared to translate the new developments into the language of the non aeronautical engineer

DR FAY COOPER COLES, retiring vice president and chairman of Section H of the American Association for the Advancement of Science, in his address at the meeting held in December last at Des Moines, paid a warm tribute to the educational system for natives established by the British in the former German territory of Tanganyika The subject of the address, which is printed in *Science* for Mar 7, was the relation of anthropology to Indian and immigrant affairs—a subject upon which Dr Coles is peculiarly competent to speak in virtue of his residence of four years among the natives of the Philippines while collecting and recording information on behalf of his museum The reference to the work of the British was quoted to afford a contrast with the methods adopted by the American administration in dealing with Indian affairs It was pointed out that the United States has at its disposal a mine of information and a great research organisation, yet instead of having the most advanced native policy in the world, Indian affairs are under the control of a Board of Commissioners, few of whom have been recognised as authorities on Indian life and customs, while the Indian Office has often been entrusted to men ignorant of and indifferent to Indian custom He referred to ill advised attempts to suppress Indian rites instead of moulding them gradually so as to bring about the adaptation of the Indians to modern civilisation as is being done in the case of the natives under British rule Dr Coles also referred to the practical value of anthropology in relation to immigration Now that immigrants are drawn predominantly from the south and east of Europe rather than the north west, anthropological studies would afford that knowledge of the cultural background of the incoming peoples which is essential if their absorption into the State is to be facilitated and they are to be prevented from consolidating into compact communities perpetuating the Old World feuds and customs which, in present conditions, delay their participation in American life

AT a recent meeting of the Geological Society of America, Col Lawrence Martin, chief of the Division of Maps at the Library of Congress, announced that two consultants, in geology and geography respectively, have been added to the Library services The specialists at the Library, termed consultants, as distinguished from the incumbents of the several 'chairs', have lately been increased for a period by a grant from the General Education Board which, by providing small honoraria, has enabled six such specialists to be added to the service The essential difference between the incumbents of 'chairs' and the research consultants is that the former are engaged in the administration of divisions of the Library of Congress, as well as in the interpretation of the materials under their custody, while the consultants serve in a purely individual and advisory capacity, rendering counsel in response to suggestions and inquiries, by visit or

by correspondence The geologist and the geographer who, for part of the present year, are to be associated with this advisory service as consultants are Prof A C Lane of Tufts College, Mass, who will come within the group provided by the grant of the General Education Board, and Prof A P Brigham of Colgate University, Hamilton, N Y, whose service, however, will be purely honorary This consultant service is purely experimental, its continuance depends on the use made of it

IN the British Broadcasting Company's regional scheme, five twin radio transmitting stations are to be constructed, each of which will be capable of radiating simultaneously two programmes on different wave lengths The five centres will be located in Scotland, North England (industrial), London and south east England, the Midlands, and the south west of England The Midlands station at Daventry and the London station at Brookmans Park, are already in operation In a paper read to the Institution of Electrical Engineers on May 7, P P Eckersley and N Ashbridge gave some of the considerations which led to the choice of these sites, and gave also a detailed description of the Brookmans Park broadcasting station In choosing this site, account had to be taken of the fact that for several years listeners in the neighbourhood of London had been accustomed to listen from a two kilowatt transmitter in Oxford Street To erect a fifty kilowatt transmitter on the same site would produce an intolerable 'wipe out' If they had chosen a site eastwards on the Thames estuary much of the service area would have been over the North Sea In a southerly direction the erection of masts on the top of the North Downs, which would have been a good site, was prevented by civil aviation regulations The site finally chosen lies on the east side of the Great North Road, on the London side of Hatfield It is in the centre of a flat field 34 acres in extent Diesel engines are used to produce the 500 kilowatts required, and very special precautions have been taken to prevent a break down as continuity of supply is essential If any essential valve breaks down, it can be replaced in about fifteen seconds

THE raw materials required by the Osram Works at Hammersmith come from all parts of the world In an article in the General Electric Company's bulletin for February, an interesting account is given of the materials used for Osram lamps The metal tungsten from which the filaments are made is obtained from scheelite, a whitish yellow stone of rough texture which is found in north eastern Australia In its rough state it is shipped round the Cape of Good Hope to London, where in the Osram works it undergoes the processes of crushing, grinding, washing, acid treatment, and heating The final result is the fine and very heavy black powder, which is pure tungsten It is then pressed, hammered, and drawn into the familiar lamp filament Shellac, which is one of the essential ingredients forming the cement which attaches the lamp cap to the glass bulb, comes from India The insects which form it breed in countless numbers in the valley of the Ganges They absorb the flowing sap from young shoots of young trees and then exude a resinous secretion over their whole bodies The twigs bearing the insects are gathered and from them commercial shellac is produced The nickel and copper used in the special leading in wires which conduct the current in and out the lamp bulb come from Canada The tin for solder comes from Malay The sand, soda, and lime used for making the glass of the bulbs is got in England, and so also is the minute amount of iron which helps to make the alloy used for the leading in wires The diamonds used for the dies through which the filaments are drawn come from South Africa The sources of all the raw materials required for the manufacture of the electric lamps lie in British territory

IN our columns of Oct 19, 1929, p 629, mention was made of the fact that the Imperial Agricultural Research Conference had recommended that the Low Temperature Research Station at Cambridge should issue from time to time lists of elaborated titles of useful publications in the field of food investigation and a brief review of the first of these lists was given We have now received the second part of the first volume of this index (Department of Scientific and Industrial Research Index to the Literature of Food Investigation Vol 1, No 2, September 1929 Compiled by Agnes Elisabeth Glennie Pp iv + 154 London H M Stationery Office, 1930 2*s* net) The arrangement of the sections and subsections is similar to that in the previous part It is proposed to include in the first number of each annual volume a brief review of the previous year's progress in the subject of food investigation This bibliography should be extremely useful to all workers on the production and preservation of different articles of food, by putting them in touch with work being carried out in other countries than their own

THE restoration of Avice's cottages to form the Portland Island Museum has been completed, and we learn from a communication from Mr H J Sansom and Dr Marie C Stopes, honorary secretary and honorary curator, respectively, of the Museum, on behalf of the Museum Committee, that all the expenses of restoration have been fully paid up The Museum is now ready to receive antiquities and specimens associated with Portland Particularly welcome would be old prints and maps of Portland, books containing references to Portland, either scientific, historical, or purely literary, well authenticated furniture, coins, etc, pre historic remains and fossils found in Portland, preserved specimens of the existing flora and fauna, photographs of famous buildings built of Portland stone, legends, folk songs, song games, old customs, etc, written down by Portland folk Glass-fronted display cases are wanted and also money for an equipment fund As the building is now ready, it is hoped to hold the opening ceremony during the last week in July of this year Specimens and exhibits should if possible be accompanied by a letter giving the fullest available information about each, and should be addressed to the Portland Island

Museum, c/o Mr H J Sansom, Pennsylvania Castle, Portland

There has been in the past some little confusion in regard to methods of specifying access of daylight into buildings The method adopted is based on the use of either of two factors, the 'daylight factor', which is the ratio of the internal illumination to the illumination of a horizontal surface exposed to a hemisphere of sky, and the 'sill ratio', which is the ratio of the internal illumination to the illumination of a horizontal surface exposed to half a hemisphere of sky (as is the case for a surface resting on the window sill) The second of these factors is necessarily double the first In the series of papers, technical papers on illumination research, issued by the Department of Scientific and Industrial Research, it was intended to use the sill ratio In 1928, however, international agreement to make use of the daylight factor was attained, and accordingly this method is to be used in all future publications of the Illumination Research Committee The only existing publications of the Committee in which values of the sill ratio are employed are those on "The Natural Lighting of Picture Galleries" (No 6) and "The Penetration of Daylight and Sunlight into Buildings" (No 7) In both cases the values should be halved so as to express them in terms of the 'daylight factor'

Two discoveries of special interest in the anthropological field are recorded in the recently published Report of the National Museum of Canada for 1928 Dr J Wintemberg has found a camping site of the extinct Beothuk Indians on the north side of Belle Isle, and a camping ground of the Iroquois near Kegashka Both discoveries add to the territory known to have been ranged by these tribes The interesting tribes of the Beothuk, who formerly lived in Newfoundland but have long been extinct, are thus shown once to have occupied the east corner of Labrador, a fact not hitherto known, while the Iroquois discovery is several hundred miles east of the known range of their forays Although these are the most interesting of the discoveries made by the museum staff in the field during the year, excellent work was done by other expeditions Dr Harlan I Smith was collecting archæological and ethnological specimens in British Columbia and taking motion pictures of the Salish, Blackfoot, and Cootenay Indians, Mr C M Barbeau was studying French Canadian arts and crafts in Quebec, Dr J C Boileau Grant conducted anthropological investigations on Cree and Chippewayan Indians on Lake Athabasca, and Mr C B Osgood travelled on the Mackenzie River, where he wintered with a band of Hare Indians on Great Bear Lake

The late Mr J D Logan presented to the trustees of the National Botanic Gardens at Kirstenbosch, South Africa, forty acres of land near Matjesfontein in the Western Karroo, where the interesting succulents in which the Karroo is so amazingly rich may be cultivated under natural conditions Prof R H Compton, director of the Kirstenbosch Gardens, has a brief article upon this interesting garden experiment in the *Kew Bulletin*, No 2, for 1930 This Whitehill Garden was seen by many of the visiting botanists during the recent meeting of the British Association and much interest was aroused The district is extraordinarily rich in species, Prof Compton has collected approximately 400 species of flowering plants and ferns in the garden itself, or on Karroo rocks in the immediate vicinity With a winter rainfall which probably averages only 5 inches per annum, these plants include a number of the striking succulents for which this region of the Karroo is famous The area was enclosed by a goat proof fence when first selected in 1920, but it was only in 1925 that it was possible to appoint a curator The gardens are financed entirely from private subscriptions and no public body makes any contribution to its support As Prof Compton says, therefore "progress is slow and the future precarious", but the plants in this garden are so extraordinarily interesting that it is earnestly to be hoped that this uniquely interesting experiment in botanical gardening will prove a permanent success

At the anniversary meeting of the Royal Society of South Africa, held on Mar 19, the following officers were elected *President* Dr W A Jolly, *Honorary Treasurer*, Dr L Crawford, *Honorary General Secretary*, Dr B F J Schonland

The Secretary of State for the Colonies has made the following appointments in the Colonial Agricultural Services Mr A E Haarer, district agricultural officer, Tanganyika Territory, to be agricultural lecturer, Tanganyika Territory Mr A B Harper, to be produce inspector, Nigeria

It is announced in *Science* that the Rumford Premium of the American Academy of Arts and Sciences was presented on April 9 to Dr John S Plaskett, director of the Dominion Astrophysical Observatory, Victoria, B C, in recognition of his researches on stellar spectroscopy

A discussion on magnetism is to be held by the Physical Society on Friday, May 23, at the Imperial College of Science, Imperial Institute Road, South Kensington, S W 7 The meeting will consist of two sessions, 3 4 30 P M and 5 15 7 P M, and the discussion will be opened by Sir Alfred Ewing, with a contribution on "Ferro Magnetism and Hysteresis" Other contributors to the discussion include Dr E C Stoner, Prof H S Allen Prof C G Darwin, Mr W Sucksmith, Mr F C Powell, Prof W Peddie, Prof P Weiss and Dr R Ferrer Prof W Gerlach, Dr P Kapitza, Dr W L Webster, and Dr L F Bates Admission is free without ticket

Mr R A Watson Watt, writing from Datchet, points out that the note in Nature of May 10, p 717, on halo phenomena of May 1, did not refer to the really rare occurrence of the halo of 46° He adds "About 17 h G M T on May 1 I saw from Datchet the 22° halo, two exceptionally brilliant mock suns, with short arcs of the mock sun ring, and the upper two thirds of the 46° halo, which was more brilliant and more definitely coloured than on any other of the three or four occasions on which I have seen it"

WE much regret to announce the death on May 13, at sixty eight years of age, of Dr Fridtjof Nansen, the distinguished Arctic explorer and naturalist

AT a general meeting of the members of the Royal Institution, held on May 5, it was announced that the Managers had received and accepted from the Trustees of the Rockefeller Foundation an offer of a donation of £20,000 for endowment of research in the Davy Faraday Laboratory, on condition that the sum of £50,000 for the same purpose should be secured by the Royal Institution from other sources before June 30, 1933, with an additional payment of £1000 per annum up to a total of £3000 for maintenance of research in the Laboratory until such time as the capital payment should be made The thanks of the members were returned to the Trustees of the Rockefeller Foundation for their generous proposal

THE Second International Congress for Sex Research will be held in London in the house of the British Medical Association, Tavistock Square, on Aug 3–9 Among the subjects to be discussed at the general meetings are puberty and maturity, physiology of the sex glands, hormone therapy Membership is restricted to professional biologists engaged in research on, or teaching in accredited institutions, anatomy, anthropology, botany, medicine, physiology, psychology, sociology, veterinary science, or zoology and to members of the medical profession Those wishing to take part in the Congress should apply to the Congress Secretary, Department of Animal Genetics, King's Buildings, The University, Edinburgh

THE Council of the Royal Society of Edinburgh has made the following awards Keith Prize for the period 1927–29, to Dr Christina C Miller, for her papers on the slow oxidation of phosphorus trioxide, published in the *Proceedings* within the period of the award, and in consideration of subsequent developments on slow oxidation of phosphorus, published elsewhere, Neill Prize for the period 1927–29, to Prof E B Bailey, in recognition of his valuable contributions to the geology of Scotland, two of which have recently appeared in the *Transactions* of the Society under the titles of (1) "Perthshire Tectonics Loch Tummel, Blair Atholl, and Glen Shee", and (2) "Schist Geology Braemar, Glen Cluny, and Glen Shee", James Scott Prize for the period 1927–30, to Prof Niels Bohr, who will deliver an address, in terms of the award, on May 26 next

A CHANGE has recently been made in the administration of the one time Laura Spelman Memorial Fellowships A Social Science Research Training Committee, under the chairmanship of Sir Josiah Stamp, has been in existence for two years, awarding scholarships intended to encourage quantitative and exact treatment of social and economic problems This Committee has now been merged for purposes of advice in the field of economics with the Fellowship Advisory Committee of the Rockefeller Foundation for the Social Services in Great Britain and Ireland Applications for fellowships should come, in all cases, not from candidates themselves but from a competent academic or other authority familiar with the candidate's qualifications All correspondence should be addressed to the secretary of the Committee, Mr N F Hall, University College, Gower Street, London, W C 1

WHEN the Society of Glass Technology, which has its headquarters in the Department of Glass Technology of the University of Sheffield, visited Aachen in May 1928 to hold a joint meeting with the Deutsche Glastechnische Gesellschaft, an invitation was given to the German society to pay a return visit to England The invitation has been accepted and the return visit will take place on May 26–June 3 next The party is expected to number about sixty Social functions and visits to works and laboratories have been arranged, starting at Sheffield, and including Chesterfield, Castleford, Knottingley, St Helens, Stourbridge, and London June 2 will be devoted to joint meetings of technical committees of the two societies On June 3 joint general meetings will be held at the Institution of Mechanical Engineers, London, at which all interested will be welcome

THE retirement of Prof H F Newall from the chair of astrophysics at Cambridge, which he occupied from its creation in 1909 until last year, provided an opportunity for recognising in a suitable way his great services to astrophysics, and it was agreed by a large body of subscribers that a portrait of Prof Newall be presented to the University to commemorate the founder of this new and active department of astronomical research at Cambridge On Saturday last, May 10, in the Master's Lodge of Trinity College, the portrait, painted by Mr Fiddes Watt, was presented by Sir J J Thomson to the University and accepted by the Vice Chancellor (the Master of Magdalene College) Sir Frank Dyson, the Master of Trinity College, the Vice Chancellor, and Sir Joseph Larmor spoke warmly of Prof Newall's work, and Prof Newall acknowledged the kindness of the subscribers both in England and abroad The portrait is to be hung in the director's room of the Solar Physics Observatory

A VERY complete summary and survey of the hospital service in the United States is given in the *Journal of the American Medical Association* for Mar 29 (vol 94, No 13, pp 921 991) The total capacity of all hospitals and sanatoriums is given as 907,133 beds and 47,939 bassinets, and it is suggested that there is an over supply of general hospitals Data are given of the staffing, laboratories, X ray departments, number of beds, and average patients per bed, and also of approved clinical laboratory service

A VOLUME of 'collected' papers, 48 in number, by members of the staff of the London Hospital and Medical School, has been issued under the title "Researches published from the Wards and Laboratories of the London Hospital during 1929" (London H K Lewis and Co, Ltd, 7s 6d net), all of which have appeared in current journals and transactions A wide range of subjects is dealt with—clinical medicine and surgery, bio chemistry and physics, physiology, pathology and bacteriology, and zoology Some of the papers are of much interest and importance, particularly one by Dr Donald Hunter recording

a case of over function of the parathyroid gland caused by a parathyroid tumour, with rapid restoration to health on its removal The volume is issued by a 'selection committee', of which Mr Hugh Cairns is honorary secretary

MESSRS Dulau and Co, Ltd, have just issued a catalogue (No 176) of upwards of 700 second hand works on botany and horticulture Copies of the catalogue can be obtained free upon application

APPLICATIONS are invited for the following appointments, on or before the dates mentioned --A principal of the Government Technical Continuation and Commercial School, Kingston, Jamaica - The Secretary, Board of Education, Whitehall, S W 1, or, for Scottish candidates, The Secretary, Scottish Education Department, Whitehall, S W 1 (May 24) An analytical chemist under the Marine Biological Association of the United Kingdom—The Director, Marine Biological Laboratory, Plymouth (May 27) A technical officer in the Admiralty Technical Pool, with experience in the design of telephones, bells, buzzers, and similar electrical instruments used in low power signalling systems—The Secretary of the Admiralty (C E Branch), Whitehall, S W 1 (May 27) An assistant lecturer in political science at the London School of Economics and Political Science--The Secretary, London School of Economics, Houghton Street, Aldwych, W C 2 (May 29) An assistant lecturer in biology at University College, Nottingham —The Registrar, University College, Nottingham (May 29) A lecturer in charge, with training in engineering and workshop practice, for branch of the Witwatersrand Technical College, near Johannesburg —Chalmers and Guthrie (Merchants), Ltd, 9 Idol Lane, E C 3 (May 31) A sanitary inspector under the Sudan Medical Service —The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S W 1 A principal of the proposed Department of Business Administration at the London School of Economics—F W Lawe, 44 Hans Crescent, S W 1 A lecturer on hygiene and physical training at the Training College, Truro—The Principal, Training College, Truro A chief lecturer in the electrical engineering section of the engineering department of the Halifax Municipal Technical College--The Principal, Municipal Technical College, Halifax A full time lecturer in mining and engineering subjects at the County Technical College, Mansfield —The Principal, County Technical College, Mansfield An assistant chemist at the South Eastern Agricultural College, mainly for arsenic estimation by the electrolytic method—The Secretary, South Eastern Agricultural College, Wye, Kent A zoologist and an algologist at the Port Erin Marine Biological Station—The Registrar, The University Liverpool

Our Astronomical Column

Conjunction of the Planets Venus and Jupiter— An interesting spectacle for the naked eye will be provided by the conjunction of the planets Venus and Jupiter on May 17 The nearest approach of the two bodies will occur at 7 P M when their distance apart will be only 1¼° This will, however, be nearly two hours before sunset The two planets will set at about 11 o'clock (Summer Time) and should offer an interesting configuration during about an hour and a half preceding that time The higher object of the pair will be Venus, which will be a little above and to the left of Jupiter This will provide an excellent occasion on which to estimate the difference of colour and magnitude of the two orbs

Comet 1927*d*—M Ebell gives the following elements of this comet in *B Z* No 21

T 1930 June 12 7904 U T

$$\left.\begin{array}{ll}\omega & 187°\ 20\ 13\\ \Omega & 81\ 27\ 11\\ i & 20\ 24\ 44\end{array}\right\}1930\ 0$$

$\log q$ 0 01283

Ephemeris for 0^h

	R A	N Decl
May 16	16^h 59^m 43^s	37° 18′
20	17 31 6	36 27
24	18 15 37	33 56
28	19 17 52	27 54

The comet is approaching both sun and earth, so is likely to become brighter It is only 8¼ million miles from the earth on June 3

The Lowell Planet—Prof Stroobant has found an image on the plates taken at Uccle Observatory in 1927 which very probably belongs to the Lowell planet He is fairly certain that it is a heavenly body, not a flaw on the plate, and it fall accurately on the trajectory of the planet

The position is as follows for the equinox of 1927 0

1927 Jan 27^d 21^h 27^m 41^s U T, R A 7^h 1^m 59 7^s, N Decl 21° 17′ 59 5″, magnitude, 15 to 15 5

On comparing this position with those computed from the two parabolas deduced by Prof Banachiewicz and Dr C H Smiley, it is found to lie 0 7 of the way from the receding parabola to the approaching one, the separate ratios being 0 695 from the R A 0 714 from the Decl, the former has three times the weight of the latter Hence, if the identification is correct, the body is approaching the sun, and the eccentricity may be estimated as about 0 4 The observations in 1930 favoured *recession* rather than *approach*, but the observed arc was not long enough to settle the question

'Wolf's Numbers' for 1929 -No 122 of *Astronomische Mitteilungen* contains the counts of sunspots, made during the year 1929 by 55 observers at various stations, from which the Wolf, or relative sunspot, numbers are deduced Tables are given for (1) daily values for the sun's whole disc, (2) daily values for a central zone the diameter of which equals half that of the disc, (3) monthly values for the whole disc The 'number' deduced for the year 1929 is 65 0, the corresponding values for the years 1923–28 inclusive are—5 8, 16 7, 44 3, 63 9, 69 0, 77 8 Table 3 shows that the least active month of 1929 was September (34 4), and the most active, December (108 0) On no day of the year was the sun free from spots Advance data, corresponding to those given in Tables 1 and 2 of the above publication, are included in the quarterly circulars issued from Zurich by Prof Brunner under the auspices of the International Astronomical Union

Research Items.

Chumash Prehistory.—In 1927 and 1928, Mr. Ronald L. Olson spent some weeks excavating in the neighbourhood of Santa Barbara, California, and on Santa Cruz Island. The more important finds are reviewed and comparison between the sites of the two areas made in vol. 28, No. 1, of the *University of California Publications in American Archæology and Ethnology*. In both cases difficulty was experienced in finding burials that had not previously been rifled by relic hunters. The sites on the area facing the ocean front are of the familiar shell mound and kitchen midden type, varying in size from an insignificant scattering of a few thousand fragments up to deposits twenty feet thick. On the islands the sites are larger and more abundant. It is probable that they were occupied only seasonally and not all the year round. In all the mounds there is a progressive diminution in number of objects as the bottom of the mound material is approached, especially noticeable in the bottom two feet. This is due mainly to a decrease in shell and bone objects. Differences in pattern and style in the objects are scarcely noticeable. Mortars, pestles, metatés and mullers, flint work, fish hooks, and barbs and ornaments, if present at the various levels, show uniformity throughout. One mainland site, however, showed that there was a change in the prevailing method of grinding when the lower strata were laid down; metaté and muller were used almost exclusively, but later gave way to mortar and pestle. Post-European objects were found on these sites. It is probable that shell heaps yielding metatés and mullers are the oldest. The stratigraphical evidence points to (1) An early mainland period; (2) An intermediate mainland period; (3) A late mainland period. On the islands an early island period equates with the last phase of the early mainland and the beginning of the intermediate. A late island period occurs in which European objects are found. The sites yielded no evidence of oceanic contact, though canoes and circular shell fish hooks were found.

Human 'Missing Links'.—In the Smithsonian Report for 1928, Gerrit S. Muller deals with this topic as illustrated by *Pithecanthropus erectus* and *Eoanthropus dawsoni*. The author commences by giving a general statement of the question at the present time, and points out that there is a considerable divergence of opinion on the subject. The two types are essentially different in that the *Pithecanthropus* remains consisted of an ape-like skullcap, ape-like teeth, and a man-like femur, while *Eoanthropus* furnished a man-like brain case, man-like teeth, but an ape-like lower jaw. He then discusses whether an agreement on the position of the two forms is possible. Instead of giving an answer, he takes each type in detail and gives a full summary of all the published opinions on the various different points in connexion with them. The paper is illustrated by photographs of all the actual remains or casts thereof without any attempts at reconstructions. Perhaps the most valuable part of the paper is a complete bibliography of all the memoirs or articles in which the two forms have been discussed.

Special Skin Affections Due to Common Plants.—It is probably common knowledge that some persons are especially sensitive to a substance contained in the little glandular hairs upon the Japanese primula, and through contact with this plant may develop a painful inflammation of the skin, which may last for months, or even years, unless the cause is rightly diagnosed and appropriate treatment employed. An article by K. Touton, of Wiesbaden, in *Die Naturwissenschaften* for Feb. 7, 1930, enumerates an astonishing number of less well-known cases of skin affections which have been traced in a similar way to the special sensitivity of the victims to the particular plants. In some cases, of course, prolonged exposure to the causal conditions may be necessary, as in the yellow colour of the skin, due to deposition of carotin, produced by continued indulgence in oranges, or the skin affection in the left hand sometimes occurring in the orangeries amongst the orange pickers. The author concludes his account of a long list of skin troubles caused by various familiar cultivated plants with the suggestion that on another occasion he may direct attention to some forty other plants, with which man comes frequently into contact, which have also been proved to exert a stimulating effect upon the human skin in some cases.

The Basis of Colour Changes in Animals.—Prof. G. H. Parker has published a useful summary of the state of knowledge concerning chromatophores (*Biol. Rev.* and *Biol. Proc. Cambridge Phil. Soc.*, vol. 5, p. 59, 1930). Active colour changes in animals are conspicuously developed only in the cephalopods, the crustaceans, and the cold-blooded vertebrates, and in each group a distinctive type of chromatophore has arisen. All these animals have well-developed eyes, and it would seem that in all these groups the eye plays a most important part in initiating the colour changes. But it is no direct reaction, for even in highly organised instances the chromatophoral responses partake of the nature of a reflex rather than of a higher nervous response, and must be regarded as indicating a reactive capacity of relatively low order. The colour responses may be excited through the direct stimulation of chromatophores by external influences, through hormones, or through nervous impulses, but the first is the least common of these modes. Although the biological significance of the chromatophore systems in animals is by no means obvious, it seems certain that in many creatures they are utilised in developing protective or aggressive coloration, while in others they play an important part in behaviour during the breeding season, in heat regulation, and in other such subsidiary functions. These views, however, await experimental confirmation.

Rattlesnakes of the Western United States.—Scale counts and comparative measurements made on well over a thousand specimens of rattlesnakes from most of the western States and northern Mexico, have led Laurence M. Klauber to revise the relationships of species and subspecies in that region (*Trans. S. Diego Soc. Nat. Hist.*, vol. 6, No. 3, p. 95, 1930). The general tendency of his investigation is to show that these areas are peopled by a series, seven in number, of subspecies of *Crotalus confluentus*, and that California and Nevada forms hitherto ranked with the tiger rattlesnake (*C. tigris*), also belong to *confluentus* as connecting links. One result of the new ranging of subspecies is that in certain cases two subspecies of the same species have overlapping areas of distribution without showing any intergrading forms. By some, such a condition is supposed to be impossible, but the author does not see why it should not occur, and thinks that overlapping of conspecific forms is most likely to occur in regions, such as that west of the Rockies, relatively contorted both topographically and climatically.

Philippine Camphor.—In the *Philippine Journal of Science*, Vol. 41, No. 2, February 1930, Augustus P. West and H. Taguibao give the result of the examina-

tion of young trees of the laurel camphor, *Cinnamomum camphora*, which have been planted by the Philippine Bureau of Forestry since 1910, with seeds obtained from Japan In Formosa and Japan the bulk of the crystalline camphor is obtained by a crude process of distillation from the wet wood of old trees, the leaves containing mainly camphor oil In these young trees in the Philippines, very little camphor was found in the wood, but the leaves yielded 2 7 per cent on the dry weight The authors point out that some of the trees examined contained practically no crystalline camphor in the leaves, but these trees yielded a lævo rotatory camphor oil distinct from the camphor oil of commerce, which is dextro rotatory and occurs along with the crystalline camphor The authors discuss the possibility of obtaining supplies of camphor from the Philippine trees able to compete with the synthetic product made from the pine tree turpentine, which contains usually about 70 per cent pinene They point out also that the Philippine pines (*Pinus insularis*) may be a valuable source of this synthetic competitor, as they appear to yield a turpentine rich in pinene

Hybridisation in the British Flora —Messrs E M Marsden Jones and W B Turrill, of the staff of the Herbarium, Kew, have a very clear note on this subject in the *Gardeners' Chronicle*, Mar 15 Their general conclusion, based on taxonomic observation and breeding experiments with common plants of the British flora, is that "hybridization is one, but only one, of the factors of organic evolution" They describe the origin of a tetraploid hybrid, a 'culti species' which breeds true, by crossing under controlled conditions *Saxifraga rosacea* with *S granulata* The same hybrid has been recorded as occurring naturally on the Continent They compare the behaviour of the two genera *Silene* and *Centaurea* In *Silene* natural hybridisation, effective in maintaining new forms, seems to occur only *within* the species, amongst the various forms included in this taxonomic group The two species *S maritima* and *S vulgaris* will cross readily and do hybridise in Nature, but the resultant hybrid forms seem to have no permanence in Nature and are only found in limited regions where the habitats of the two species overlap In *Centaurea*, on the other hand, in the '*nigra*' group, hybridisation between certain taxonomic species is extremely frequent and seems to be responsible for the existence of a large number of these taxonomic units, which are either hybrids, segregates, or the results of back crosses to one parent The authors conclude definitely that the chief cause of polymorphism among the British knapweeds is hybridisation and that plants considered as distinct species by a specialist on the genus are hybrids The distinction between this inter specific hybridisation in *Centaurea* and the intra specific hybridisation in *Silene* obviously cannot be over stressed, as it depends, in part, upon the relative extent to which specific analysis has been applied by the taxonomist within a group of allied forms in two different genera

A New Ordovician Gastropod —With great difficulty sufficient material has been obtained by Mr E Kirk to justify the description of a new Ordovician gastropod from the Great Basin region of Nevada (*Proc U S Nat Mus*, vol 76, art 22) *Mitrospira longwelli*, n gen et sp, is highly characteristic of a fairly narrow zone in the upper portion of the Pogonip beds Despite its sinistral aspect, the author gives reasons for considering it to be an extreme hyperstrophic example of a dextral shell allied to *Maclurites*, for one species of that genus in the Pogonip at times shows a slight eversion of the whorls giving a slightly convex outline to the lower surface So far, no antecedent form to *Mitrospira* has been met with and the only other known gastropod with which it may be compared is *Palliseria*, Wilson An interesting feature shown by vertical sections is that the apical whorls were progressively filled with secondary deposits of lime during the life of the animal, very similar to that which occurs in certain species of *Natica*

The Tango (Japan) Earthquake of Mar 7, 1927 — Although the Tango earthquake of 1927 has been more closely studied than perhaps any other earthquake, Prof S Nakamura has added some interesting facts in a paper recently translated into English (*Science Reps of the Tohoku Imp Univ*, vol 18, pp 419 472, 1929) The two faults along which displacements occurred have been described in these pages (NATURE, vol 122, p 36) The author visited the Japan Sea coast ten days after the earthquake The previous sea level was well marked by lines of living shell fish and sea weeds, showing that the coast had been elevated from a point 1¼ miles east of the seaward end of the Gomura fault to a point about 7 miles to the west of it The maximum uplift, of 2 feet, occurred about the middle of this distance Some idea of the intensity of the shock is given by the maximum acceleration of 4500 mm per sec per sec at Mineyama, a town almost completely destroyed by the earthquake Many observations on the rotation of objects were made, and it was found that the anti clockwise rotation prevailed near the Yamada fault and the clockwise rotation near the Gomura fault The shear along the former fault was clockwise and along the latter anti clockwise

Climatic Changes in Central Asia The theory of the progressive desiccation of western Central Asia has been supported by Sir Aurel Stein, Prof E Huntington and others who have examined the evidence on the spot It has, however, been rejected by other travellers, including Dr Sven Hedin and Prof J W Gregory In a paper in the *Geographical Journal* for April, Lieut Col R C F Schomberg discusses the climatic conditions in the Tarim basin, and comes to the conclusion that changes in aridity and distribution of population have been caused not by climatic changes but by natural deviations in the course of streams The soft friable nature of the soil lets stream courses change easily Any slight increase in the volume of a stream may throw it off its course and mean the abandonment to aridity of large areas Again, a river cutting downwards tends to be impeded and so diverted by its banks caving in The abandonment of cultivation may be caused not only by a river changing its course, but also by the level of the water falling, as the bed is cut downwards, and becoming too low to be available for convenient irrigation Col Schomberg discusses also the value of evidence obtained by the existence of dead tamarisk and other trees which have often been cited as evidence of weather conditions in the past He finds this evidence somewhat perplexing, since at times a luxuriant growth of new tamarisk occurs side by side with many dead bushes

Absorption of Sound —When standing waves are set up in a pipe having a source of sound at one end, and a reflecting diaphragm at the other, the relative amplitudes of the changes of pressure at nodes and antinodes will be determined by the extent to which the energy reaching the diaphragm is thrown back into the pipe Some measurements of the absorption coefficients of a number of materials by this method are described by A H Davis and E J Evans in the

April number of the *Proceedings of the Royal Society* A loud speaker was used as the source of sound, and the standing waves set up in an iron tube 30 cm in diameter and 250 cm long, the end of which was closed by a steel disc supporting the test specimen in a wooden ring The change of pressure through the tube was found by means of a second smaller tube, connected to an external electrical registering system The materials investigated were mostly those which are fairly good absorbers of sound, and records were obtained of the effects of the thickness of material and method of mounting, as well as of the effect of variation of the frequency of the sound The important consequences which may accompany a change in the state of a specimen are well illustrated by some results given for a cane fibre board 1 1 cm thick For a frequency of 1200 cycles per second it was found that the ratio of the absorbed energy to the incident energy was 0 07, when the board was drilled with 480 holes per square foot, each hole being 5/32 inch in diameter, this ratio was increased to 0 53

Jet-Wave Rectifiers —In a paper read to the British Association at Leeds in 1927, Prof Jul Hartmann described a jet wave rectifier he had invented for converting alternating current into direct current The alternating current flows along a thin jet of falling mercury which is put into synchronous oscillation with the current The end of the jet makes connexion alternately with two contact pieces connected with the opposite ends of a transformer winding The positive pole of the direct current is taken from the middle point of the transformer winding and the negative pole from the nozzle end of the jet The rectified current in the jet wave can be quite large, as mercury is a conductor The jet is cut by a tungsten knife placed between the two contact pieces The commutation is accompanied by a transient arc, and to reduce the energy losses in the arc was one of the main problems in designing the device The contact pieces are mounted in a chamber kept filled with hydrogen, because, with the possible exception of helium, this gas is the only one which is able to absorb the energy of the spark in the small time available for this to take place The duration of the spark in atmospheric air is about ten times as long as its duration in hydrogen Commercial rectifiers having an output of 200 kilowatts at 550 volts have been developed at the municipal power station of Copenhagen Experiments were tried on a large scale with a jet wave rectifier working in parallel with rotary converters Severe short circuits caused practically all the converters to fall out of action, but the jet wave rectifier continued to act during the short circuit and afterwards The author, in his paper to the Institution of Electrical Engineers read on Feb 13, points out that the jet wave rectifier provides a means for the production of very high direct current voltages at a reasonable cost He thinks that a 100 kilowatt direct current rectifier can be made from a hundred very simple jet wave commutators connected in series

Machine Telegraph Systems —Telegraphy and telephony are now comparable, as both can bridge the distance between two points on the earth's surface The valve amplifier with loaded conductors has done this for telephony, and the regenerative repeater, loaded conductors, and the valve have done it for telegraphy The paper, therefore, on machine telegraph systems which was read to the Institution of Electrical Engineers by H H Harrison on Mar 27 was a timely one He pointed out that although inland telegraphy, at least in Europe, is in a bad way financially, international telegraphy is remunerative In Europe, inland telegraphy is controlled by government departments, but in America, where it is successful, it is conducted by two privately owned companies The success, however, is mainly due to the fact that America is a land of long distances This and other economic factors enable the telegraph not only to survive but also to flourish in spite of the growth of its rival In Europe, a factor in favour of telegraphy is the difference in local times As we move eastward, an hour has to be added to the time for every 15° of longitude It is possible to telephone to America during normal business hours between 2 and 5 P M Greenwich time Talking eastwards must proceed in the morning, commencing at 9 A M, but it cannot be carried out farther east than China This difference in local time constitutes the only factor operating against world wide telephony The sole effect on telegraphy is to cause a change in the direction of the traffic, which flows eastwards and westwards alternately except when the working days overlap Either wired or radio telegraphy is bound to survive The most serious problem that remains to be solved is how to make inland telegraphs pay in countries where distances are comparatively short The principal obstacle is the cost of retransmission at the various stations, and this will probably be solved by making all these operations automatic

Turbo-Generator at Hell Gate Station, New York — There are many advantages in using very large turbine generators in central stations, and it is difficult to see what cause will ultimately limit their size Working steam pressures are also continuing to increase A pressure of 1200 pounds per square inch a few years ago was considered quite outside the practical working range Now it is well established and turbine builders are preparing for the coming of pressures up to 3000 pounds per square inch More than a year ago, a 165,000 kilowatt, two unit set was installed by Brown Boveri of Baden in the Hell Gate Station, New York In size it far outstrips all other electrical apparatus In the *Westinghouse International* for February, a description of this machine is given It is 91 5 feet long, 40 feet wide, and rises 27 5 feet from the floor It weighs 1300 tons, and would light a million homes at once or provide excellent illumination for a highway twice round the world A notable feature is the high speed of the rotor, which makes 1800 revolutions per minute Per unit generated it is more compact and cheaper than smaller turbines The necessary ventilation is provided by three vertical type blower fans which are placed below and between the generators This effects a considerable saving in the floor space No less than 275,000 cubic feet of air per minute are supplied to keep the electric generators cool when fully loaded Further details of this turbine are given in the *Brown Boveri Review* for January

Chemical Effects of X-rays —Clark and Pickett, in the February number of the *Journal of the American Chemical Society*, describe the action of X rays on several chemical systems known to undergo photochemical change in ultra violet light Most of the changes, if any, were very small The most sensitive reactions found besides the oxidation of ferrous to ferric salts were a series of aldehyde-ketone condensations Colloidal lead used in the Blair Bell technique for cancer therapy was studied from the points of view of preparation, stability, coagulation by X rays, production of secondary X rays, and catalytic effects in reactions subject to irradiation The conclusion was reached that the specific chemical effect rather than the action of producing secondary X rays *in situ* in the tissues is indicated

The *Snellius* Expedition

By Commander P. M. VAN RIEL, Chief of the Oceanographical Department, Royal Netherlands Meteorological Institute, Leader of the Expedition.

IN view of the lack of knowledge concerning the inland seas between Asia and Australia, the Society for Scientific Researches in the Dutch Colonies and the Royal Dutch Geographical Society at Amsterdam planned an oceanographical, geological, and biological expedition to those parts for the years 1929–30. The field of research, shown on the accompanying chart (Fig. 1), embraces the deep basins in the eastern part of the Dutch colonies with the adjacent regions of the Pacific and the Indian Ocean which they connect. The area is nearly as large as that of the Mediterranean and the Black Seas combined. The conditions are very different from those in the open ocean and render this part of the Archipelago a region of great interest for oceanographical, geological, and biological work.

In view of these joint interests the scientific staff is composed as follows: an oceanographer leader, with two oceanographers (one chemical, one physical), a chemist, a geologist, and a biologist. The scientific equipment of the research vessel (H.M.S. *Willebrord Snellius*, a surveying ship of 1200 tons) was transported while she was being built in Holland. By the co-operation of the East Indian Government and the Navy Department at Batavia, this ship is being withheld from her ordinary surveying work and put at the disposal of the expedition for fifteen months. The naval staff is composed of a commander, four naval officers, a naval engineer, a doctor, and a paymaster.

The main purpose of the expedition is to acquire more data concerning the physical and chemical properties of the sea water, the horizontal and vertical circulation in the various layers, the configuration of the bottom and its deposits, and the distribution of the plankton. Moreover, biological and geological investigations ashore and on coral reefs form part of the programme.

The investigations of ocean temperatures, the salinity and the amount of oxygen of the water, the determination of currents by calculation and direct measurements, and the meteorological observations directly connected with oceanography, are in charge of the leader of the expedition, assisted by Dr. H. J. Hardon and Mr. H. C. Hamaker. Commander F. Pinke and his officers and men are responsible for a considerable amount of work, of which echo soundings, the determination of the position of the ship, and laboratory work form the principal part.

The chemical investigations are in charge of Dr. A. B. Boelman. The determinations are to be such as will help and complete the oceanographical, geological, and biological work, not such as would be of purely chemical interest; hence determinations of salinity, oxygen content, alkalinity, and pH were chosen. The first is only of oceanographical, the second of both biological and geological interest. As already mentioned, these two are under the direct supervision of Dr. Hardon. Alkalinity measurements belong to the geological side, those of the pH to all three together. Up to the time of writing no opportunity had occurred for determinations of the phosphate content. It is hoped that it will be possible to make some phosphate determinations in the future, for these, together with quantitative plankton fishing, afford valuable information on the biology of the seas.

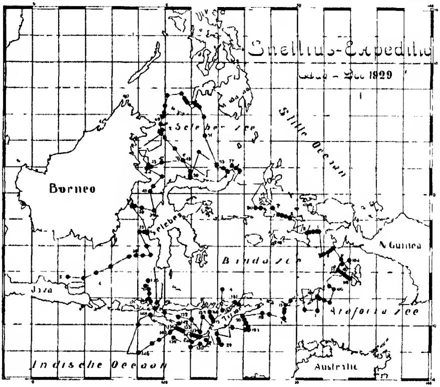


FIG. 1.

Data of importance for geology are obtained by the echo soundings that are made at frequent intervals during the sailing, and by wire soundings with a bottom sampler at each station. Dr. Ph. H. Kuenen, the geologist, is responsible for the latter.

The task of the biologist, Dr. H. Boschma, is confined to investigations which may help to give a better understanding of geological phenomena. At sea the biological work consists of the collection of plankton—surface catches at nearly every station, and, occasionally, catches with closing nets or large tow nets for macroplankton. Every now and then (twice or thrice a month) a couple of days are spent ashore together with Dr. Kuenen, then collections are made of the animals inhabiting the reefs and the shore. The results of the investigations ashore are mostly of local interest, but these observations

on reefs and reef islands will no doubt prove to be of more general importance when viewed as a whole

To the small number of existing wire soundings off the shelves many thousands of echo soundings are being added These will enable us to make corrections on the present depth chart

The track of the ship during the first five months is plotted on the chart (Fig 1), the dots representing the position of the stations In most cases observations have been made along cross-sections of the troughs between the isobaths of 200 m, so as to allow calculation of currents in various layers by the methods of dynamical oceanography

Interesting results have already been obtained concerning the physical and chemical properties of the sea water in the deep basins which are separated by rather shallow sills Direct current measurements have been made at two anchor stations (39° and 135°, depth 2300 m and 1200 m respectively), where the influence of the tide near the bottom was observed (135°) Moreover, investigations have been carried out at these stations concerning the variations in the properties of the sea water, probably due to internal waves

Optical Rotatory Power

THE Faraday Society's second General Discussion on "Optical Rotatory Power" was held in the rooms of the Chemical Society, Burlington House, London, on Friday and Saturday, April 25 and 26 In addition to English workers in this field of research, the Society had the pleasure of welcoming a large delegation of their foreign colleagues, from France, Germany, Italy, Belgium, and Switzerland The foreign guests included Prof R Betti (Bologna), Dr Bretscher (Zurich), Prof E Darmois (Paris), Dr R Descamps (Brussels), Dr Drucker (Leipzig), Prof P P Ewald (Stuttgart), Dr Werner Kuhn (Heidelberg) Mme Liquier Milward (a pupil of Prof Cotton, now resident in England), Dr R Lucas (Paris), and Dr K Wolf (Karlsruhe) Papers were also received from Prof G Bruhat and Prof A Cotton (Paris), and Prof R de Mallemann (Nancy), who were unable to attend the meetings

An introductory address by Prof Ewald on the physical aspects of optical rotatory power was listened to with interest, and will be read with still greater interest when it appears in print This was followed by a paper on "The Wave Mechanics of Optical Rotation and of Optically active Molecules" by Mr G Temple, of Trinity College, Cambridge Up to the present, wave mechanics has contributed but little to the theory of optical rotatory power, but it appears likely that the challenge provided by this discussion may result at no distant date in the development of a satisfactory method of formulating the older experimental results in terms of the newer theory At present, some confusion has arisen from attempts to identify the symmetrical and antisymmetrical forms of the molecule, as they exist in hydrogen and in ammonia, with the dextrorotatory and lævorotatory forms of an optically active compound Since these forms differ in energy content, they must therefore differ (at least slightly) in rotatory power This conclusion is, however, directly contrary to the well established postulates of Pasteur, and to the doctrine, held universally by all workers during the past hundred years, that enantiomorphism implies an absolute identity of properties, except when these are reversed in sign, but not in magnitude, by reflection in a mirror This anomaly is one that must be removed as soon as possible, if the newer theories are to prove their equality to or superiority over the old, and Dr Kuhn (whose simple model of an asymmetric molecule seems likely to provide a bridge between theory and experiment) has already suggested that, instead of being identified with the symmetrical and antisymmetrical solutions of the wave equations, the dextro and lævo forms should each be represented by a combination of these two solutions, with an appropriate difference of phase, so that the precise equality of the mirror image is restored

The theory of wave mechanics also postulates that all optical activity is unstable and only of transient duration, but without specifying whether the half-life period is to be reckoned in millions of years or in millionths of a second Under these conditions, it is impossible to check the theory against experiments, which have established the apparent permanence of optical activity, but, since racemisation (or the related phenomenon of inversion of one of a series of asymmetric carbon atoms, as in the mutarotation of the sugars) is so often found to depend on a catalyst, many physical chemists would envisage the process as one that occurs normally only in complex molecular systems, although the inversion of pinene vapour has been claimed as an example of an uncatalysed reaction The racemisation postulated by the theory of wave mechanics is therefore apparently a phenomenon of a different order from those which have been studied by chemists

Dr Werner Kuhn, who contributed a paper on "The Physical Basis of Optical Rotatory Power", has achieved unique success in deriving from theoretical physics results which are sufficiently simple to be of immediate practical value In particular, whilst Drude's simplified equation for rotatory dispersion is valid only in a region of complete transparency (his complete equation has not yet been tested against experiment), Kuhn's equation is valid right through the region covered by an absorption band Drude's equation has the merit of having made it possible for the first time to resolve the rotatory power of unsaturated compounds into partial rotations of high and low frequency, which are often of opposite sign, but this analysis is obviously less exact than that of Kuhn, and it is of interest to know that the discrepancy which the writer has observed repeatedly between the characteristic frequencies deduced from direct measurements of absorption and (with the help of Drude's equation) from measurements of rotatory dispersion, can be predicted from Kuhn's equation, in which this discrepancy does not occur

The three following papers, by Dr K Wolf, Dr H G Rule, and Prof R Betti, were all concerned with the influence of polarity on rotatory power, a subject on which Dr Rule has published a long series of papers in recent years Dr Wolf in a paper on "The Principle of Free Rotation in Optically Active Molecules" described the measurements which he has made of dipole moments, for example, of the active and meso forms of tartaric acid and its esters, in order to find out whether 'free rotation' occurs about the central bond He concludes that it does not, but this result can be attributed in some cases to the chemical effect of subsidiary valencies, and further experiments are contemplated on compounds in which this factor is unlikely to be operative Prof Betti, who contributed a paper on "Optical Rotatory Power and Chemical Constitution", has prepared a series of derivatives of the base, $HO\ C_{10}H_6\ CH(C_6H_5)\ NH_2$, and in order to eliminate the effects of rotatory dispersion, has calculated the 'absolute' molecular rotations of his compounds He has thus been able to establish a graphical relation,

first between the rotatory power of an alkylidene derivative, $HO\ C_{10}H_6\ CHPh\ N=CHX$, and the dissociation constant of the corresponding acid $X\ COOH$, and *secondly* between the rotatory power of the compound and its dipole moment One of his curves leads to the remarkable conclusion that, if the dipole moment were reduced to zero, the rotatory power of the compound would also disappear or become very small

In the section of the discussion dealing with apparatus and methods, only the paper of Dr Descamps on "Ultra violet Polarimetry" was communicated to the meeting

The papers of Prof Darmois and of Mme Milward dealt with the effects of neutral salts on the rotatory power of (1) tartrates and tartaric esters, (2) asparagine The tartaric esters always show a depression of rotatory power, but in the case of the salts an exaltation is sometimes observed These effects are attributed to the deformation of the tartaric radical, and to variations in the hydration of the tartaric ion In the case of asparagine, it was suggested that neutral salts act by turning the molecule into a *zwitterion*

$$NH_2\ C_2H_3(CONH_2)\ CO\ OH \rightleftharpoons \overset{+}{N}H_3\ C_2H_3(CO\ NH_2)CO\ \overset{-}{O}$$

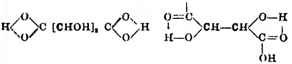
This effect was interpreted as depending on the polarisation of the molecule under the influence of ions bearing charges of opposite sign

Issues of a more controversial character were raised in the discussion of the origin of the variations of optical rotatory power in solution Measurements of rotatory dispersion have proved that the anomalous rotatory dispersion of ethyl tartrate can be expressed as the sum of *two* simple partial rotations of opposite sign, but, in order to explain the effects of temperature, Dr Lucas has had to assume the presence of *three* modifications of the ester He has also postulated that these may depend on the existence of three maxima of stability in the 'free rotation' of one half of the molecule relative to the other It was unfortunate that, in the absence of Prof G Bruhat and of Prof T S Patterson, the opposite view (which regards all the anomalies of tartaric acid as normal attributes of the molecule, HO CO CHOH CHOH CO OH) was defended only in writing Dr R Lucas had no difficulty in showing that the variations of rotatory power with concentration and temperature are not, as Bruhat suggests, theoretically incompatible with a dynamic equilibrium between various isomeric forms of the acid, since this deduction is only valid if the solvent is regarded (as in the early history of the theory of electrolytic dissociation) as equivalent to empty space It has also been established, by experiments on compounds such as ethyl acetoacetate and benzoyl camphor, that the equilibrium concentrations of dynamic isomerides are displaced by changes of solvent, perhaps in response to variations in the relative solubility of the various forms

In defence of Arndtsen's theory, that the anomalous behaviour of tartaric acid is due to the presence of more than one form of the acid, Dr P C Austin urged that the real problem is not so much to explain the existence of the anomalies, as to account for their complete disappearance in certain derivatives of tartaric acid which contain the complete electronic system of the acid, but with the addition of certain radicals, as in methylene tartaric acid or borotartaric acid Until some attempt is made to explain these well-established facts in terms of the normal structure of tartaric acid, it can be claimed that Arndtsen's hypothesis (even although it remains only a hypothesis) is the only one that covers the experimental data which are now available

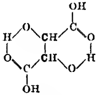
Some discussion arose as to whether the impedance of free rotation by the development of positions of maximum stability, as suggested by Lucas, would be sufficient to account for the variations of rotatory power of the different forms, and, in particular, for the reversal of sign that is required to explain the anomalous rotatory dispersion of tartaric acid and its esters According to van 't Hoff's theory of optical superposition, no change of rotatory power would be produced by free rotation about the central bond, but it was generally agreed that some modification of rotatory power might be produced by a mutual induction between the polar groups in the two halves of the molecule The writer expressed the opinion that, in view of the known tendency for carbonylic oxygen and hydroxylic hydrogen to interact (as pointed out by Pfeiffer in 1913 in the case of o hydroxy anthraquinone) it was unlikely that tartaric acid would be an exception to this rule It is therefore almost inevitable that isomeric forms of the acid should be produced according as the carbonyl radical interacts with the hydroxyl group of its own acid radical, or with one or other of the alcoholic hydroxyl groups, which are attached directly to the asymmetric carbon atoms, giving rise to systems containing rings of 4, 5, or 6 atoms, as follows

I II



4 atom rings 5 atom rings

III



6 atom rings

The proportions in which these would be present would depend on the relative stability of the various rings, and their rotatory powers would be likely to show greater contrasts than any that could be produced by the impedance of free rotation of the two halves of the molecule in formulæ I and II

The remaining part of the discussion, dealing with the chemical aspects of optical rotatory power, was largely non controversial in character Dr W H Mills gave an admirable account of the conditions under which molecular dissymmetry of the most varied type can give rise to optical activity His own study of impedance of free rotation by steric hindrance in the naphthalene series, following on Kenner's discovery of optical activity arising from a similar impedance in the diphenyl series, is of special interest as a case in which thermal agitation alone might suffice to produce a momentary removal of the constraint and so give rise to racemisation without the aid of a chemically active catalyst Dr J Kenyon then contributed two papers, on "Relations between the Rotatory Powers of the Members of Homologous Series", and, with Dr H Phillips, on "Some Recent Developments in the Study of the Walden Inversion", which also did not lead to any keen discussion, since they were mainly a record of well established facts

After the meetings in London, almost all the foreign guests made the journey to Cambridge, where a

reception was given in the Laboratory of Physical Chemistry, at which Prof and Mrs Wiegner of Zurich were also present In addition to exhibits of polarimetry, refractometry, ultra violet and infra red spectroscopy, photochemistry, electron bombardment, molecular rays, and a number of exhibits in branches of physical chemistry less directly related to optical rotatory power, the adjoining Magnetic Laboratory was thrown open to inspection by permission of Sir Ernest Rutherford, and Dr P Kapitza was able to show the production of liquid and solid hydrogen, which has been suspended in Great Britain since the death of Sir James Dewar T M LOWRY

Archæology and Bible History

PROF JOHN GARSTANG'S Friday evening discourse on "The Historicity of the Books of Joshua and Judges" delivered at the Royal Institution on May 9, apart from the intrinsic interest of any topic relating to the archæology of the Bible, was notable as affording some further examples of the way in which recent archæological investigation has served to confirm tradition The discovery of evidence in Mesopotamia tending to substantiate the authenticity of the story of the Flood in the Bible and in Sumerian legend is a case in point, and Prof Garstang himself referred to the confirmation of the Homeric account of Achæan activities in Asia Minor afforded by recent Hittite discovery

Repeatedly when visiting sites under excavation in Palestine since the War, Prof Garstang has been deeply impressed by the sense of material reality underlying the narrative in the Books of Joshua and Judges It is now generally agreed, as the result of critical textual study, that these books in their present form were composed and amplified by various schools throughout a period of seven hundred years For the purpose of his discourse, Prof Garstang dealt only with the archæological problems raised by the older portion of the text, and it was with the specific object of studying these problems that his excavations at Jericho, Ai, and Hazor were undertaken in 1928 In addition he revisited every identified site mentioned in the oldest sources No radical flaw was found in the topography and archæology of these documents

The results of Prof Garstang's investigations as summarised in his discourse are of profound interest and of singular significance in their bearing upon the historicity of these Bible narratives All the identified sites mentioned in Joshua and Judges i to v, such as Gezer, Megiddo, Bethshean, and Hazor, flourished in the Bronze Age, and for the most part were positions of strategic importance The names of no less than twenty four cities of the Canaanites in the age of Joshua are identical with those mentioned in the annals of Pharaohs of the xviiith Dynasty, especially from Tothmes III to Akhenaten, that is from 1475 to 1375 B C Among the cities which the Israelites could not capture were Bethshean, Megiddo, Acco, Gezer, Jerusalem, and Gaza These are found to be organised centres of Egyptian authority It thus becomes clear that the background of the exploits of Joshua was that disclosed by the Egyptian records of the fifteenth century B C

Prof Garstang's excavations at Jericho, Ai, and Hazor in 1928, and further investigations at Jericho early in the present year, fully bear out this interpretation It has been found that each site shows traces of destruction near the middle of the late Bronze Age or about 1400 B C Ai and Hazor were abandoned as from that time, and Jericho was not rebuilt for centuries At Bethel and Debir layers of destruction have been disclosed which are to be dated at the end of the fifteenth century Bringing these results into relation with the tradition that the Exodus took place 480 years before the building of Solomon's temple, that is, about 1447 B C, the date of Joshua's invasion of Canaan would fall about 1407 B C This tradition has been mistrusted, but if the later additions to the Book of Judges are disregarded, the discrepancies disappear

Thus, Prof Garstang concludes, all available archæological and literary evidences point to the same date in the middle of the late Bronze Age, and the historical and topographical allusions in the Books of Joshua are found to be in accord with the material results of investigation Further, Israel's position under the Judges falls into the frame afforded by Egyptian chronology and the record of Egyptian relations with Canaan The records of both books were founded on fact

University and Educational Intelligence

BIRMINGHAM - The University having been associated with the Birmingham General Hospital as constituting the Birmingham centre of the Radium Commission, 1 gm of radium has been lent by the Commission to the General Hospital and 0 5 gm to the University The radium lent to the University is to be used for the production of radium emanation (radon) and a small building for this purpose is being erected as part of the Physics Department under the control of the Poynting professor of physics, Prof S W J Smith The radon produced is to be distributed to all hospitals which are at the present time recognised by the Faculty of Medicine as teaching institutions connected with the University Certain other institutions in the area, on making application to the Faculty and furnishing evidence of suitability, will also be supplied

CAMBRIDGE —Dr W E Dixon, of Downing College, has been reappointed reader in pharmacology

MANCHESTER —A bronze plaque of the late Prof W H Perkin, presented by former students and friends, will be unveiled in the Chemistry Theatre of the University on Saturday, May 24, at 11 A M, and friends of the late Prof Perkin are invited to be present

The Council has accepted the offer of Mr James Grier and Mr Harry Brindle to institute two silver medals in pharmaceutics The medals will be offered annually for competition to the students of the chemist and druggist course and of the pharmaceutical chemist and B Sc in pharmaceutics courses

OXFORD —The sixth annual report of the Lewis Evans Collection was presented to Convocation on May 6 by the curator, Dr R T Gunther, of Magdalen College It contains an account of the restoration work on the Old Ashmolean Building which has been carried out by the University Chest, and records the installation of the new armorial windows on the main staircase A long list of accessions to the Collection is included, and the report goes on to point out that if the original 'Officina Chemica" in the basement, at present used for the storage of books, could be made available, it would be possible to refit "the most historic laboratory in Britain with its own apparatus", much of which was used there by Charles Daubeny a hundred years ago The report ends with a record of the lectures and research work undertaken and the publications issued during the past year, together with a note as to the financial needs of the Collection

On the motion of Dr F W Pember, Warden of All Souls', Congregation has passed a decree authorising a grant of £50 towards the expenses of an expedition organised by a body of undergraduates who propose to make during the present year an ecological survey of Lapland and western Norway

Historic Natural Events

May 18, 1680 Hailstorm in London —According to Dr Hooke, about 10 30 the sky grew very dark and there was thunder, very near Soon after there began to fall "a good quantity of hailstones, some of the bigness of pistol bullets, others as big as pullets' eggs, and some above 2½ inches and near 3 inches over the broad way, the smaller were pretty round, and white like chalk or sugar plums, the others of other shapes"

May 18–19, 1888 Thunderstorms —On the night of May 18–19, a thunderstorm passed across England and southern Scotland from south to north at the rate of 50 miles per hour On May 19 there was a series of isolated thunderstorms In Glasgow the storm was described as 'the most awful occurrence of the kind which has been recorded in the annals of the Observatory' It was accompanied by torrential rain and hailstones as large as pigeon's eggs Much damage was done by lightning in several parts of the country, and people were killed at no fewer than ten different places in southern Scotland and northern England

May 19, 1780 'Black Friday' or The Dark Day' – In New England on May 19, 1780 the sky was cloudy and the sun was just apparent and of reddish hue in the early morning Then it rained slightly and thundered and the darkness grew, so that large print could not be read, nor could business be transacted Schools were dismissed, and all work ceased Fowls went to roost as at night, frogs began to pipe, night birds sang and cocks crow The darkness began to clear at 1 30 P M and by 3 15 P M the light was as usual for a thick cloudy day

May 19, 1809 Hailstorm in London —A violent thunderstorm began about 5 P M accompanied by hailstones an inch in diameter Carried by a strong south wind, they destroyed a great number of sky lights and south windows, and collected in great drifts The stones travelled with such speed that they left clean round holes in the glass, like bullet holes

May 19, 1811 Whirlwind near Sheffield — A whirlwind, accompanied by hailstones up to five inches in circumference, tore up seven trees by the roots broke others in the middle, and unroofed many buildings Nearly all the water was carried out of a mill dam and dispersed in the air

May 21, 1846 The Beginning of the Notably Hot Summer –This date was the beginning of the Notably Hot Summer' and severe drought which continued until Sept 23 From the effects of this amazing summer, many horses and some men died, and many kinds of provision were much spoiled, whether bread, meat, cheese, butter, ale or wine, and many other articles were greatly injured The corn harvest was very early, and the wheat crop good This was, for continuance, the hottest summer since 1780, if not since 1750, but 1818 and 1826 were rather similar

May 21, 1890 Refraction Phenomena —The rising sun at Brunn in Bohemia was observed to take a series of remarkable shapes before it finally rose well above the horizon and became circular The earliest form was a conical tower with a flat cap, changing through cylindrical to urn shaped The next stage showed the form of a mushroom complete with a short stem, and finally the stem became detached and gradually disappeared The whole series of changes occupied eight minutes

May 24, 1681 Drought —Under this date Evelyn records 'There had scarce fallen any rain since Christmas" On June 11 he adds, "It still continued so great a drought as had never been known in England In the Rector's Book of Clayworth, Notts, June 18 "Barley found dry in ye fields, having lain so, ever since sowing time", and in his summary of the year It was a very dry and drought year fro ye beging of April [the Rector's year began on April 1, old style] to yo 20th June, not having raynd, except on ye 7th of May" At Towneley in Lancashire the rainfall this year was only 76 per cent of the average

May 24, 1783 Dust Haze From May 24 until almost the middle of August there was an unusually dense and very persistent high fog over the whole of Europe Asia Minor, Syria, Iceland, and many other countries This was probably due to volcanic dust from the eruption of Laki, Iceland The weather was greatly disturbed in Europe there was a persistent southerly wind and great heat and the Nile flood was abnormally low The following winter 1783 84, was very long and very rigorous over the whole of Europe and in North America Gilbert White records hard frost so late as April 2

Societies and Academies

London

Physical Society, May 9 **E J Williams** (1) The induction of electromotive forces in a moving liquid by a magnetic field and their application to the investigation of the flow of liquids Preliminary experiments on the flow through straight tubes show that potential differences of the order of 10^{-4} to 10^{-8} volt set up by a magnetic field in a moving liquid consisting of an aqueous solution of copper sulphate can be satisfactorily measured —(2) The motion of a liquid in an enclosed space The increase of resistance of a column of mercury in a magnetic field is due to the internal motion of the liquid produced by the action of the ampere forces between the magnetic field and the electric current traversing the mercury The hydrodynamic significance of the results of such experiments is considered, e m f 's as small as 10^{-8} to 10^{-7} volt induced by a magnetic field in moving mercury, can be accurately measured —**E Simeon** The generation of sound by the siren principle The paper discusses various undesirable features of the simple siren considered as a sound source for technical work, and describes a siren with a reasonably pure note, the intensity of which can be kept constant throughout a range of pitch from about 70 to about 7500 cycles —**L Hartshorn** Surface resistivity measurements of solid dielectrics The paper describes (1) a new form of electrode suitable for surface resistivity measurements on insulating materials in sheet form, and (2) a method for the determination of the 'volume leakage' correction for any system of electrodes Data are given on the volume leakage correction for the various types of electrode in general use, and on the leakage resistivities' of materials commonly used in the construction of laboratory instruments

Paris

Academy of Sciences, Mar 31 —**Mesnager** Must the solution of the problem of the cylinder given by Saint Venant sometimes be rejected? A criticism of a recent communication by Henri Villat and Maurice Roy Without questioning the mathematical work, the author is not in agreement with the practical interpretations deduced —**Marcel Brillouin** Dynamical tides with continents The law of depth and the attraction of the ring —**C de La Vallée Poussin** The conformal representation of plane areas multiply connex —**Paul Pascal and René Lecuir** The chemical and magnetic study of complexes derived from the triazine nucleus —**A Tonolo** A physical interpretation of the tensor of Riemann and of the principal curvatures of a

variety V_2.—**Mohamed A. Haque**: The magnetic double refraction of ethyl alcohol, of water and of aqueous solutions of nitrates.—**F. Baldet**: Observations, with the large Meudon telescope, of the celestial body discovered at the Lowell Observatory. A trans-Neptunian planet, with the distance and diameter given by the discoverers, should shew a planetary disc of about 1·0", of the same order of magnitude as the satellites of Jupiter, and this should be easily visible with the large telescope of the Meudon Observatory (83 cm. objective), which has a separating power of 0·17". Observations on four days, one under exceptionally good conditions, failed to shew any trace of a disc.—**E. Henriot** and **Mlle. A. Marcelle**: The direct measurement of the ratio of the absolute retardations in double refraction by deformation.—**B. Bogitch**: The preparation of blue glass and the decomposition of sodium sulphate by silica.—**M. Prettre** and **P. Laffitte**: The inflammation and combustion of carbon disulphide. For percentages of carbon disulphide vapour varying between 1·3 and 34·0 by volume, the temperatures of inflammation vary linearly between 138° C. and 338° C. For mixtures containing more than 10 per cent of carbon disulphide, luminescence of the gaseous mixture is observed before inflammation, but this is always less intense than that observed in the case of carbon monoxide. In all the experiments there was noticed a slight brown deposit on the walls of the apparatus: this was shewn to be the monosulphide, CS or a polymer.—*Marcel Godchot* and **Max Mousseron**: New methods of formation of 2: 5 dimethyl piperazine. Three new methods are given, the first two starting with 2: 5 dimethylpyrazine: catalytic reduction with hydrogen in presence of nickel at 150°-160° C., reduction with hydrogen in acetic acid solution with platinum as the catalyst: the third method, the simplest, is the reduction by hydrogen in presence of platinum in acetic acid solution of isonitrosoacetone.—**F. François**: The action of selenoxanthydrol on ureas and carbamic esters. The typical reaction between xanthydrol and ureas and carbamic esters occurs when the oxygen of the pyrane nucleus is replaced by sulphur or by selenium.—**Paul Gaubert**: The dehydration of heulandite.—**Henri Vincienne**: Stratigraphical and tectonic observations on the southern termination of the Crédo chain.—**Henri Mémery**: The winter of 1930 and solar activity.—**H. Buisson, G. Jausseran,** and **P. Rouard**: The transparency of the lower atmosphere. The results of direct measurements of atmospheric absorption over distances of 600 metres and 2500 metres for wave-lengths varying from 5780 to 2482. It is hoped to extend the results to smaller wave-lengths.—**Link** and **Hugon**: Direct measurements of atmospheric absorption.—**V. N. Lubimenko** and **Mme. Rauser-Černooussova**: The fossil remains of chlorophyll in marine mud deposits. Observations published in 1921 suggested that the pigment of chlorophyll, in the absence of oxygen, possesses great stability and might be preserved as a fossil substance. Results are given in the present paper confirming this view. Four specimens, of varying age, one belonging to the Tertiary age, gave alcoholic extracts containing chlorophyll, as shown by spectroscopic examination.—**Jakob Eriksson**: The hibernation of *Puccinia Ribis* is the vegetative state in the winter buds of the plant acting as host.—**J. des Cilleuls**: The phytoplankton of the Loire in the course of the summers of 1928 and 1929. Owing to the exceptional warmth and dryness of the summers of 1928 and 1929 the plankton of the Loire was unusually abundant, recalling a lake regime. Analogous observations were made on the plankton of the Elbe, near Dresden, and also near Hamburg, during the dry summer of 1904.—**Pierre Dangeard**: The mobility of certain cells of *Porphyridium cruentum*.—**Raymond-Hamet**: The physiological analysis of the intestinal action of Uzara.—**Georges Truffaut** and **V. Vladykov**: The microflora of the rhizosphere of wheat.—**J. Vellard**: Antivenomous vaccination. Results of experiments on the production of vaccines exerting a protective action against the bites of poisonous snakes.—**J. André Thomas**: A neoplasic reaction due to the degenerescence of the ovocytes and sometimes of the bristles in *Nereis diversicolor*. The formation of conjunctive tissue from the newly formed amibocytes.

ROME

Royal National Academy of the Lincei, Jan. 19.—**T. Levi-Civita**: Characteristics and bicharacteristics of Einstein's gravitational equations (2).—**U. Cisotti**: Dynamic actions of circulatory currents around a bilateral strip or an arched strip. The considerations advanced in an earlier note are illustrated by two concrete examples.—**V. Nobile**: Intermediary trihedra of reference for stellar dynamics; criteria of choice.—**L. Cambi** and **A. Cagnasso**: The reactions between ferrous compounds and nitric oxide (2). Nitric oxide undergoes association with ferrous salts having anions of slight electro-affinity and of a high degree of oxidisability (such as the carbonate, hydrogen carbonate, and acetate), giving first nitroso-salts with groupings (NO') having a halogen-like function unlike that of hyponitrous acid, into which such groupings undergo subsequent transformation. This transformation is effected by decomposition with silver salts in a neutral or feebly acid medium, or by a sufficient increase of the pH value, such as is caused by addition of excess of the alkali salt of the same acid as is present in the ferrous salt used.—**R. G. Harrison** and **P. Pasquini**: Grafting experiments with *Clavelina lepadiformis* (Muller).—**L. Petri**: Experimental reproduction of *mal del secco* of lemons. This disease, which causes serious damage to lemon plantations on the eastern coast of Sicily, is the result of attack by two distinct fungi. The wood is first attacked by *Deuterophoma*, which causes tracheomycosis or adromycosis, which is shown externally only by partial or total yellowing of the leaves and cortical tissue. This primary phase of the disease renders possible subsequent antracnosis of the buds and young branches, the cause in this case being infection with *Colletotrichum glœosporioides* Penz. The disease may be produced by artificial inoculation with the two organisms.—**Rina Baldoni**: Systems of principal normals to a variety at its π_2 (1).—**S. Cherubino**: A general theorem on real Abelian varieties.—**N. Cioranescu**: Approximation of a function by another function belonging to a given linear functional, and approximation of any vectorial field by an irrotational field.—**H. Lewy**: The unicity of the solution of Cauchy's problem for an elliptical equation of the second order in two variables.—**A. Lusis**: Investigation of the permutable functions of the first species with a given function.—**Maria Cibrario**: The non-existence of congruences W of certain hyperspacial straight lines.—**R. L. Gomes**: Isoenergetic movements.—**B. Finzi**: Dynamic actions relative to plane irrotational currents of viscous liquids. The analytical formulæ recently deduced are applied to the determination of the dynamic actions exerted on a rigid profile enclosed by a regular current.—**G. Viola**: Fluctuations of the light curve of U Cephei. The various hypotheses capable of explaining this phenomenon are discussed.—**G. Scagliarini** and **P. Pratesi**: Potentiometric determination of alkaline sulphides. The interaction of sodium nitroprusside and an alkaline sulphide results in the formation of a complex salt comprising one molecule of each of the reagents. Investigation of the curve of electrometric titration of

decinormal solutions of the two compounds reveals a well marked point of flexion corresponding with equivalence of the solutions This result furnishes the basis for a method of determining sulphides, even in the presence of large proportions of other salts —Z Jolles and J Krugliakoff Investigations on diazo hydrates, azoxy compounds, and nitrones It was recently found that normal diazohydrates exhibit all the properties characteristic of an energetic oxidising agent Further experiments show that the same is the case with the analogous compounds, α and β azoxy compounds, nitrosophenylhydroxylamine, and nitrones —M Anelli A geological section of the Reggian Apennines — G B Cacciamali Problems of Lombardy tectonics (with reference to investigations on the sub soil) —S Di Franco The lava from the eruption of Etna in 1928 Study of the different lavas of Mount Etna shows that these may be grouped into seven types The lava from the eruption of 1928 is dark grey, tending to reddish, and moderately heavy, and is analogous microscopically to those of the later eruptions and also to some of the older ones It contains pheno crystals of plagioclase, augite, and olivine, disseminated in a basic mass composed of plagioclase, augite, magnetite in abundance, and vitreous substance in small proportion It belongs to type III of the author's classification —G Mezzadroli and E Vareton Further investigations on the action exerted by a radio oscillator for ultra short waves (2 3 metres wave length) on the germination of seeds and on the growth of plants (2) Experiments on cotton, beans, peas, and maize show that when seeds and plants are subjected to the action of these waves, the germinators being placed between the coils of the receiving oscillating circuit, the effect is even greater than that observed with an interposed Lakhovsky oscillating circuit or with systems of Lecher wires in the zone of greatest intensity

VIENNA

Academy of Sciences, Feb 20 —R Schumann The vectorial adjustment of triangle nets —A Skrabal The development of chemical mechanics Our kinetic equations of 'relation' are valid as limiting laws for constant media, that is, for dilute systems They can be generalised and carried over to systems however variable if for relations we substitute 'activities' —G T Whyburn (1) Possibly regular point quantities —(2) The structure of regular curves —(3) Irreducible partition quantities —G Lock Cannizzaro's reaction —M Beier Zoological expedition to the Ionian Islands (8) Coleoptera, with the help of A Schuster, R Hicker, and H Strouhal —(9) Spiders, with the help of E Reimoser and C F Roewer

Feb 27 —K Fuchs and P Gross The action of alkali organic compounds on aromatic sulphonates The experiments were carried out in a nitrogen atmosphere —P Gross and A Goldstern Optical determination of electrolytic dissociation in very dilute alcoholic solution Coefficients of extinction were measured in solutions of lithium picrate alone and with addition of lithium chloride, and in picric acid alone and with addition of lithium chloride —F Heritsch A coral from the Grauwacke zone of the Veitsch in Upper Styria —A Dadieu and K W F Kohlrausch Studies on the Raman effect (7) The Raman spectrum of organic substances

Mar 6 —B Machan Two new fish forms from Padang —M Beier Zoological expedition to the Ionian Islands (10) The shell bearing land and fresh water molluscs, worked out by F Käufel —P Gross and M Iser Salting out The distribution of acetone and of prussic acid between benzol and the aqueous solutions of various salts —T Pintner Further contributions to the anatomy and systematics of *Tetrarhynchus* —K Menger A distance concept in groups —G Nöbeling N dimensional universal spaces

Mar 13 —P Gross and S Klinghoffer The influence of alkali chlorides on the solubility of calcium iodate —O Schindler A new *Hemirhampus* from the Pacific Ocean —E Späth and K Gibian The constitution of sappanin —E Späth and J Pikl New bases in angostura bark quinoline, 2 methylquinoline, 2 n amylquinoline and 1 methyl 2 keto 1, 2 dihydroquinoline —K Przibram (1) The coloration of kunzite —(2) The influence of cathode rays on the swelling of gelatin

Official Publications Received

BRITISH

Transactions of the Optical Society Vol 31 No 1 1929-30 Pp iv + 52 (London) 10s

The Scientific Proceedings of the Royal Dublin Society Vol 19, N S Nos 29 39 29 Studies on Peat, Part 3 Low Temperature Carbonization of Peat, by James T Donnelly and Joseph Reilly 30 The Nitration of Substituted Phenylbenzylamine Derivatives by J Reilly, T V Creedon and P J Drumm 31 A Study of Two new Species of Bacteria belonging to the Genus *Chromobacterium*, by Dr M Grimes 32 The Thermal Instability of the Earth's Crust II Dr J H J Poole 33 Study of the Polysaccharides Part 1 Inulin and Inulan, by J Reilly and P P Donovan 34 Responses of Plant Tissues to Electric Currents II by Prof H H Dixon and T A Bennet Clark 35 Electrical Properties of Oil Water Emulsions with special reference to the Structure of the Plasmatic Membrane by Prof Henry H Dixon and T A Bennet Clark 36 Studies in Peat Part 4 Low Temperature Carbonization under various Conditions by Colm O Sullivan and Dr Joseph Reilly 37 The Application of Gamma Radiation to Deep-seated Tumours by Dr J Joly 38 A Study of the Polysaccharides, Part 2 Note on the Purification of the Natural Products by J Reilly and Declan T McSweeney 39 Some Geochemical Applications of Measurements of Hydrogen Ion Concentration by Dr W R G Atkins Pp 365 460 (Dublin Hodges Figgis and Co London Williams and Norgate, Ltd) 6s

Harper Adams Agricultural College Newport, Shropshire Grassland Problems the Making of Grassland, the Maintenance of Grassland the Utilisation of Grassland, Report of Conference held at the College on Wednesday February 5th 1930 Pp 15+ix Sugar Beet Problems Report of Third Conference held at the College on Thursday March 13th, 1930 Pp. 28 (Newport)

Transactions of the Institute of Marine Engineers, Incorporated Session 1930 Vol 41 April Pp 983 990+lxxvi+xxxviii (London)

Papers and Proceedings of the Royal Society of Tasmania for the Year 1929 Pp v+151+31 plates (Hobart.) 10s

FOREIGN

Det Norske Videnskaps Akademi i Oslo Resultater av de Norske Statsunderstøttede Spitsbergenekspeditioner (Skrifter om Svalbard og Ishavet). Bind 1, Nr 1 The Norwegian Svalbard Expeditions 1906–1926 By Adolf Hoel Pp 104+2 plates (Oslo Jacob Dybwad) 10 00 kr

Annuaire de l Académie Royale des Sciences, des Lettres et des Beaux Arts de Belgique 1930 96e année Pp 175 (Bruxelles Maurice Lamertin)

Agricultural Experiment Station Michigan State College of Agriculture and Applied Science Circular Bulletin No 130 Cultural Methods in the Bearing Vineyard By N L Partridge Pp. 19 Circular Bulletin No 131 The Cherry Fruit Flies By R H Pettit and G S Tolles Pp 11 Special Bulletin No. 195 Maintaining the Productivity of Cherry Trees By V R. Gardner Pp. 27 Technical Bulletin No 102 Keeping Qualities of Butter vi Experiments on the Production of Metallic Flavor in Butter and Milk vii The Microbic Flora of Off flavored Butter By G L A Ruehle Pp 46. Technical Bulletin No 103 The Pathogenicity of the Species of the Genus Brucella for the Fowl By I Forrest Huddleson and M W Emmel Pp 30 (East Lansing, Mich)

Biblioteca Nacional Exposição de Fisica, Abril de 1930 Catalogo Pp 96 (Lisboa)

U S Department of Agriculture. Farmers Bulletin No 1624 The Mexican Bean Beetle in the East and its Control By Neale F Howard Pp ii+14 (Washington D C Government Printing Office) 5 cents

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol 82 A new Woodpecker from Angola Fourth Preliminary Paper on the Birds collected during the Gray African Expedition, 1929 By W Wedgwood Bowen. Pp 89 90 (Philadelphia.)

University of Illinois Engineering Experiment Station Bulletin No 204 The Hydroxylation of Double Bonds By Sherlock Swann, Jr Pp 14 10 cents. Bulletin No 205 A Study of the Ikeda Short Time (Electrical Resistance) Test for Fatigue Strength of Metals. By Herbert F Moore and Seichi Konzo Pp 31 20 cents Bulletin No. 206 Studies in the Electrodeposition of Metals By Prof Donald B Keyes and Sherlock Swann, Jr Pp. 18 10 cents (Urbana, Ill)

Mitteilungen der Naturforschenden Gesellschaft Bern aus dem Jahre 1929 Pp xi+136+18 Tafeln (Bern Paul Haupt)

Achema Jahrbuch, Jahrgang 1928-30 Berichte über Stand und Entwicklung des chemischen Apparatewesens Herausgegeben von Dr Max Buchner Pp. 260+64+xi (Seelze bei Hannover und Berlin Dechema Deutsche Gesellschaft für chemisches Apparatewesen E V) 10 gold marks.

Acta Phytochimica. Edited by Prof Keita Shibata Vol 5 No 1, April Pp 97 (Tokyo The Iwata Institute of Plant Biochemistry)

Memoirs of the College of Science, Kyoto Imperial University Series A Vol 13 No 2 March Pp 101 178 + 11 plates (Tokyo and Kyoto Maruzen Co, Ltd) 1 50 yen

The Science Reports of the Tohoku Imperial University Sendai Japan First Series (Mathematics, Physics, Chemistry) Vol 19, No 1, March. Pp 153 + 7 plates (Tokyo and Sendai Maruzen Co Ltd)

Field Museum of Natural History Botany Leaflet 14 Indian Corn By James B MacNair Pp 34 25 cents Anthropology Leaflet 29 Tobacco and its Use in Africa By Berthold Laufer, Wilfrid D Hambly and Ralph Linton Pp 45 + 6 plates 25 cents (Chicago)

CATALOGUES

Library Sets of Standard Works English Literature, History, Translations, etc (Catalogue 524) Pp 15 (London Francis Edwards Ltd)

A Selection of Rare Books (Catalogue No 29) Pp 73 (Newcastle on Tyne William H Robinson)

Bisoxyl in the Treatment of Syphilis Pp 8 (London The British Drug Houses Ltd)

Catalogue of Books on the subjects of Botany and Horticulture (No 170) Pp 34 (London Dulau and Co, Ltd)

Diary of Societies

FRIDAY MAY 16

ROYAL SOCIETY, EDINBURGH at 4 30 —Prof G Wiegner Base Exchange (Address)

BRITISH INSTITUTE OF RADIOLOGY (Medical Meeting), at 5 —Radiology in Urinary Diseases and General

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Sir Arthur Keith The Anatomy of Fossil Man The More Recent Discoveries of Neanderthal Man in Europe The Present Position of the Neanderthal Problem

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section) (Annual General Meeting) at 7

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7

INSTITUTE OF CHEMISTRY (Belfast and District Section) (at Royal Belfast Academical Institution), at 7 30 —Annual General Meeting

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at Dundee Technical College) at 7 30 —R H Fowler Some Recent Advances in the Electron Theory of Metals (Kelvin Lecture).

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section) (Annual General Meeting) at 8 —Dr F J Hector A Case of Endometrioma — Dr G W Theobald The Toxæmias of Pregnancy a New Conception —A. J Wrigley Puerperal Infection by the Pathogenic Anaerobic Bacteria.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Dr C M Yonge The Great Barrier Reef of Australia

ASSOCIATION OF ECONOMIC BIOLOGISTS (at Forest Products Research Laboratory, Princes Risborough)

SATURDAY MAY 17

BIOCHEMICAL SOCIETY (in Department of Physiology School of Medicine, Leeds), at 8 —C Rimington (a) Some Observations upon the Colorimetric Determination of Cystine by Means of the Uric Acid Reagent (b) The Carbohydrate Complex present in the Blood serum Proteins — J B Speakman The Denaturation of Wool —W T Astbury The Inner Structure of Hairs as Revealed by X ray Analysis —F C Thompson and L Goldman The Dissociation Constants of Chebulinic Acid — F C Happold The Oxidation of Phenols by Bacterial Suspensions — C E M Pugh The Mode of Action of Tyrosinase —A Wormall and L R Johnson The Action of Sodium Hydroxide on Serum Proteins in Relation to Antigenic Activities —K Turner The Fatty Acids from the Liver of the Sheep —M Thomas HCN zymasis and H_2S-zymasis —H J Channon and G A Collinson The Ether soluble Phosphorus of Blood —J Gordon and P G Marshall The Distribution of Phosphorus in Bacterial Cultures —*Demonstrations* —W T Astbury X ray Photograph of Hair Structure —A T King The Variability in the Sulphur Content of Wool —G I Brown and B. A McSwiney Collection of Secretion from Pyloric Antrum of the Dog

PHILOLOGICAL SOCIETY (jointly with Oxford Philological Society) (at Magdalen College, Oxford) at 5 30 —Dr B F C Atkinson Ancient Illyrian

MONDAY, MAY 19

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8 30 —Lt Col R C F Schomberg Journeys in the Tien Shan

TUESDAY, MAY 20

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5 15 —D Caradog Jones Housing in Liverpool A Survey by Sample of Present Conditions

ZOOLOGICAL SOCIETY OF LONDON at 5 30 —Major S S Flower Exhibition of Photographs of Gorilla, Elephant Seals and other Animals now in the Carl Hagenbeck Tierpark at Stellingen near Hamburg —Col A E Hamerton Remarks on Trypanosomiasis in Relation to Man and Beast in Africa —A D Middleton The Ecology of the American Grey Squirrel (*Sciurus carolinensis*) in the British Isles

LONDON NATURAL HISTORY SOCIETY (at Winchester House, E C), at 6 30 —Discussion on Parasitism in Nature.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7 —Rev H O Fenton Spain Calling

WEDNESDAY, MAY 21

ROYAL MICROSCOPICAL SOCIETY (Special Meeting) (at King's College, Strand), at 3 —An Exhibition and Demonstration of the Latest Types of Metallurgical Instruments and Apparatus — At 7 — Prof Nils E Svedelius The so-called Freshwater Lithoderma —At 7 45 —Scientific Communications and Discussion on Recent Advances in Current Research and Practice in Microscopic Metallography (In chair Prof C H Desch)

ROYAL METEOROLOGICAL SOCIETY, at 5 —Sir Napier Shaw An Account of Dr Moltchanof's Method of Automatic Signalling of the Results of Sounding of the Upper Air —Sir Gilbert T Walker Seasonal Foreshadowing —A C Best Instruments for Obtaining Dry and Wet Bulb Temperatures

ROYAL SOCIETY OF ARTS at 8

FOLK LORE SOCIETY (at University College) at 8 —A D Lacaille The Bull in Scottish Folklore Place names and Archæology

EUGENICS SOCIETY (at Royal Society) at 8 30 —Raghu Vira Eugenics in Sanskrit Literature (Lecture)

THURSDAY, MAY 22

ROYAL MEDICO PSYCHOLOGICAL ASSOCIATION (at B M A Tavistock Square), at 8 —Dr A A. W Petrie and others Discussion on American Psychiatry and the Practical Bearing it may have in the Application of Recent Local Government and Mental Treatment Legislation

ROYAL SOCIETY at 4 30 —Prof G H Parker The Ciliation of the Fallopian Tube —Dr D Keilin Cytochrome and Intracellular Oxidase —L E Bayliss E Boyland, and A D Ritchie The Adductor Mechanism of Pecten —Prof H E Roaf Visual Acuity in Light of Different Colours —*To be read in title only* —Sir Charles Sherrington and J C Eccles Numbers and Contraction Values of Individual Motor Units examined in some Muscles of the Limb

ROYAL SOCIETY OF MEDICINE (Urology Section), at 8 30 —Annual General Meeting

FRIDAY, MAY 23

PHYSICAL SOCIETY (at Imperial College of Science and Technology) at 3 and 5 15 —*Discussion on Magnetism* —Sir Alfred Ewing Ferro Magnetism and Hysteresis —Dr E C Stoner Magnetism in the 20th Century —Prof H S Allen Magnetism and the Quantum Theory — Prof C G Darwin The Polarisation of the Electron —W Sucksmith The Gyromagnetic Effect and Paramagnetism —F C Powell On the Change in Size of a Ferromagnetic at the Curie Point —Prof W Peddie Magnetisation and Temperature in Crystals —Prof W Weiss and Dr R Forrer Sur l'aimentation et saturation des ferrocobalts et des nickel cobalts et les moments atomiques des trois métaux —Prof W Gerlach Über neue Zusammenhänge von magnetischen u elektrischen Erscheinungen —Dr P Kapitza Methods of Experimenting in Strong Magnetic Fields —Dr W L Webster On Magneto-striction and Change of Resistance in Single Crystals of Iron and Nickel —Dr L F Bates Observations on the Specific Heats of Ferromagnetic Substances

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Edinburgh and East of Scotland and Glasgow Sections of Society of Chemical Industry) (at Heriot-Watt College Edinburgh) at 6 —Prof J Kendall Chemistry in Naval Warfare

ROYAL SOCIETY OF MEDICINE (Epidemiology Section) (Annual General Meeting) at 8 —Dr P Stocks Immunity Changes in Measles and Whooping-Cough

ROYAL INSTITUTION OF GREAT BRITAIN at 9 —R S Whipple Some Scientific Instrument Makers of the 18th Century

SATURDAY, MAY 24

LINNEAN SOCIETY OF LONDON at 3 —Anniversary Meeting

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section) (at Leamington Spa)

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Edinburgh and East of Scotland and Glasgow Sections of Society of Chemical Industry) (at Edinburgh) (continued from May 23)

PUBLIC LECTURES

TUESDAY, MAY 20

UNIVERSITY COLLEGE at 5 30 —Prof Nils E Svedelius The Bearing of Modern Researches on Algæ especially Rhodophyceæ (Succeeding Lectures on May 22 and 23)

BIRKBECK COLLEGE, at 6 —Dr A. Mansbridge The Dedication of Life (Haldane Memorial Lecture)

WEDNESDAY, MAY 21

INSTITUTION OF ELECTRICAL ENGINEERS at 5 30 —J F Kayser Permanent Magnets and Magnet Steels (Armourers and Braziers Company Lectures) (Succeeding Lectures on May 28 and June 4)

THURSDAY, MAY 22

INSTITUTE OF PATHOLOGY AND RESEARCH ST MARY'S HOSPITAL, PADDINGTON at 5 —Prof C A Lovatt Evans Stages in the Investigation of the Physiology of the Heart

CONGRESSES

FRIDAY, MAY 16

SOCIETY OF MEDICAL OFFICERS OF HEALTH (at Harrogate) at 4 —Discussion on Rheumatism in its Public Health Aspects

MAY 19, 20, AND 21

INTERNATIONAL CONGRESS ON MALARIA (at Algiers).

MAY 26 TO 28.

CONGRESS OF LEGAL MEDICINE (at Paris)

SATURDAY, MAY 24, 1930

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The Radcliffe Observatory and its Proposed Removal

THE British National Committee for Astronomy of the International Research Council has pronounced definitely in support of the proposal to transfer the Radcliffe Observatory, Oxford, to South Africa, rather than to another site in England This was the view taken at a meeting of the Committee held on May 9, when it was also resolved "that the establishment in South Africa, under English control, of a new observatory equipped with a large reflector, and adequately endowed, would not only be in the best interests of astronomy, but is almost an imperative necessity in the interests of British scientific prestige" The resolution appears in full in our correspondence columns this week over the signatures of sixteen of the seventeen members of the Committee present A glance at the list of names should be sufficient to convince anyone that leading astronomical opinion in Great Britain is decidedly in favour of carrying on the scientific work of the Radcliffe Observatory in South Africa instead of continuing it in England

Dr John Radcliffe, whose name the Observatory bears, was a successful Court physician who died in 1714 leaving a fortune estimated at £140 000 His will provided for the building of a library in Oxford and the salary of a librarian, for travelling fellowships, for rebuilding the front of University College, Oxford, and some other purposes When the bequest of £40 000 allocated to the library became available upon the death of Radcliffe's sisters, the trustees built the Radcliffe Library and later the infirmary The residue of the real and personal estate remaining after the payment of various legacies and bequests was to be used by the trustees for "such charitable [purposes] as they in their discretion shall think best" There is no mention of astronomy in Radcliffe's will, and it was not until more than fifty years after his death that the trustees decided that the practical study of this science might be regarded as a charitable purpose and that they could therefore make provision for it

The Savilian professorship of astronomy was founded in 1619 by Sir Henry Savile, Provost of Eton Shortly after Dr Hornsby succeeded to the chair in 1762, he appealed through the Chancellor of the University to the Radcliffe trustees for funds for an observatory, and in 1771 they secured a lease (and in 1820 the freehold) of nearly nine acres for the building and grounds adjoining the Radcliffe Infirmary, which was opened a year earlier Shortly afterwards the building was put in hand, the trustees

having previously agreed to purchase the instruments suggested by Hornsby These were completed and delivered in 1773 and are still in the observatory The building was not, however, finished and furnished until towards the end of the eighteenth century Several additions have since been made, including a building for an equatorial telescope in 1903

From the foundation of the Observatory until 1839 the Savilian professor and Radcliffe observer was a joint office, but the University then elected a successor to Dr S P Rigaud without consulting the Radcliffe trustees, with the result that the trustees appointed an observer of their own, and the chair of astronomy has since then been separated from the post of Radcliffe observer

The trustees then asserted their independence, as they can in their discretion with the sum which will be at their disposal if the Charity Commissioners consent to the proposed sale of the present site of the Radcliffe Observatory for the use of the Radcliffe Infirmary As the Observatory has been in existence for more than 150 years, it is reasonable to assume that astronomy has a substantial vested interest in the sale of property which it has possessed for so long a period It seems too late now to urge that as astronomy is not mentioned in Radcliffe's will, the sum available from the sale of the Observatory site should be used for other than astronomical purposes Probably the trustees will give consideration to any such claims which may be advanced, but it scarcely seems possible now to dispute their legal right to continue to use for astronomy the benefaction which they have administered for so long for the promotion of that branch of science

Assuming, therefore, that the trustees have a substantial sum at their disposal, there seem to be two points of view as to how this might be used—one that of Oxford itself and the other that of science, which knows no geographical limitations and welcomes facilities for increase of natural knowledge anywhere It must be acknowledged, of course, that every scientific department at Oxford could make good use of the fund for the development of fields of inquiry which they are unable to explore because of lack of resources, but we wonder whether any department would be inclined to hand over to a separate branch of science an endowment which it had held for a century and a half In comparison with other subjects, astronomy is very poorly endowed in Great Britain or the British Empire The suggestion that it might now transfer to other departments of science one of its few endowments cannot, therefore, be seriously entertained

The position at present is that the Charity Commissioners have the proposed sale of the Observatory site under consideration Even if consent is given, the future site of the Observatory cannot be definitely settled for many months yet The present intention of the Radcliffe trustees, for which they hope to obtain legal sanction, is to move the activities to a site on the high veld in South Africa, in view of the excellent observing conditions there and the pressing need of more work on the southern stars Dr Steavenson is at present testing the seeing at a site outside Pretoria, using the same method as is being employed in the search for a site for the 200 inch reflector in California If the Observatory goes to South Africa, it is planned that it should be equipped with as large a reflector as the trust can afford, possibly a 72 inch, as there is an immense field of spectroscopic work, which such a telescope alone can do, awaiting to be done to complement similar work in the northern hemisphere

From the point of view of progress of astronomical science, the advantages to be gained by the establishment of an observatory in South Africa are beyond dispute Practically all the most important astrophysical work is now done with large reflectors, like the 72 inch telescope used by J S Plaskett at the Dominion Astrophysical Observatory, Canada His work on the rotation of the galaxy and the interstellar cloud especially needs to be extended to the southern sky

It would be easy to mention many other profitable lines of work for which a large reflector is required in the southern hemisphere, and also where observing conditions are more favourable than in England All observing work requiring long exposures, and all photometric work, is carried on here with difficulty and disappointment on account of uncertainties of weather, and this is harder on large telescopes than on small It is indeed unnecessary to labour the point that a big reflector is urgently needed for line of sight and other spectroscopic work, and that from many points of view the most appropriate site for such an instrument is on the high veld in South Africa, where the American universities of Harvard, Yale, and Michigan, as well as the Smithsonian Institution, have already established observing stations, and where the University of Leyden is also to have an observatory through a grant of £20,000 from the Rockefeller Institute

There should be no difficulty in arranging for a close relationship between the University of Oxford

and the Radcliffe Observatory wherever it may be The University has an observatory of its own, and the professor of astronomy, Prof H H Turner, strongly advocates the proposed removal of the Radcliffe Observatory to South Africa Such an outpost where young English astronomers could go for experience, and to which the professors at Oxford might send students, would be most useful, and friendly co-operation of this kind between the University and the Radcliffe Observatory would be easy to establish A good deal of the measurement of spectroscopic and other photographs could no doubt be carried on at Oxford, leaving the astronomers at the Observatory in South Africa free for observational work Oxford has received so much from South Africa that it might now appropriately welcome the transfer to that country of an observatory which cannot usefully extend its work under present conditions, either of site or of instruments Existing work would, of course, be continued before the removal took place We understand that if and when the sale of this site is completed, the Radcliffe trustees will take a lease for five years of the observatory buildings and part of the grounds to enable the completion of the programme of work on the proper motions of faint stars in the Kapteyn selected areas (about 30,000 stars are involved) started by Rambaut twenty years ago The actual observatory buildings would remain as a brilliant example of classical architecture, it is Sir William Morris's wish that they should be used for post graduate work in connexion with the University School of Medicine

Theoretical and Applied Colloid Chemistry

(1) *Elektrochemie der Kolloide* Von Prof Dr Wolfgang Pauli und Dr Emerich Valkó Pp xii + 647 (Wien Julius Springer, 1929) 66 gold marks

(2) *Die Kolloide in Biologie und Medizin* Von Prof Dr H Bechhold Funfte vollig umgearbeitete Auflage Pp xii + 586 + 7 Tafeln (Dresden und Leipzig Theodor Steinkopff, 1929) 32 gold marks

(3) *Équilibres superficiels des solutions colloïdales études de biophysique moléculaire* Par Dr P Lecomte du Nouy (Monographies de l'Institut Pasteur) Pp 228 (Paris Masson et Cie, 1929) 32 francs

(1) THIS imposing volume attempts, as the preface states, to base an electro-chemistry of colloids on the modern theories of electrolyte solutions It is the outcome of careful investigations continued for many years, beginning with proteins and gradually extended to many inorganic sols

The book falls into three main sections an introduction, which is a concise summary of the relevant chapters of modern physical chemistry, a general and a special electro chemistry of colloids The second section, after describing the preparation and purification of sols as well as their coagulation by electrolytes, proceeds to develop the principal theses of Pauli's theory Suspensions and colloid particles behave like electrolytes of very high molecular weight The particle consists of a neutral portion forming its main bulk, composed of insoluble and non dissociating molecules, and a small 'ionogenic' portion which is, generally speaking, a true complex compound in Werner's sense The ionogenic complex dissociates into two sets of ions, one of which is held to the neutral portion by chemical forces and imparts the charge to it, while the other forms what Pauli calls the 'counter ions' The particles may be 'isomolecular' when the neutral and the ionogenic part have the same composition, for example, in silicic acid

$$[x(SiO_2 + nH_2O)\ yHSiO_3] + yH^+$$

or 'heteromolecular', when the two parts differ in composition, as in ferric hydroxide sol

$$[x(Fe_2O_3 + nH_2O) + yFeOCl\ FeO^+] + Cl^-$$

Pauli does full justice to the earlier work of J Duclaux, who arrived at a somewhat similar 'chemical' theory by combining conductivity measurements with determinations of osmotic pressure Pauli considers the latter liable to many errors and substituted for them electrometric measurements, he also investigated sols much more highly purified by prolonged dialysis, and especially by electrodialysis than those studied by earlier workers The record of this large mass of minutely careful quantitative work deserves the most careful study To obtain complete insight into the constitution of the ionogenic complex, it is necessary to combine with the electrical methods chemical analysis, which also calls for a highly developed technique

Even this complete armoury, however, fails in some cases It is a little disappointing that it should do so with the gold sols which at first sight might seem ideal for testing the claims of Pauli's theory and its chief rival, the adsorption theory The constitution of the ionogenic complex is not definitely known, but Pauli assumes it to be an aurate or auric acid, the anion of which gives the particle its negative charge Zsigmondy and his school, on the other hand, consider that it is due

to the adsorption of OH ion On either assumption the disperse phase should contain oxygen, but careful analyses of the coagulum by both parties has failed to find any Pauli argues that the composition of the coagulum is not that of the stable particles, and that his view receives support from the analogy with hydroxide sols and more directly by recent work on platinum sols Of the adsorption theory in general he says that it "cannot be considered more than a description" Still, it seems difficult to account for the negative charge on the particles of 'pure oil water' emulsions otherwise than by the adsorption of OH ions, since no other anions are available

The reviewer must confess to a slight feeling of disappointment—probably unreasonable—on reading the application of the authors' theory to the fundamental problem of the electrolyte coagulation of lyophobic sols To attempt a theory of the stability of sols would, they say, be premature, as we have no theory of solubility, of which the stability of colloids is a special case It looks as if the experimental fact that colloidal anions, that is, negatively charged particles, give a coagulum with all cations had to be accepted like the fact that electrolytic anions give precipitates with specific cations, for example, SO_4'' with Ba The adsorption theory put forward by Freundlich to account for the valency effect is rejected by the authors, without any very clear alternative, on two grounds the empirical nature of the adsorption isotherm and the impossibility of proving that different ions are adsorbed to the same extent

It must be confessed that these doubts as to the adequacy of the authors' theory to solve all the long standing problems of colloid chemistry do not strike the reader until some time after he has finished studying their book The first impression is profound, such as a vast generalisation naturally produces on the student of a subject which has, perhaps, led a somewhat hand to mouth existence in the way of theory, a generalisation, moreover, supported by a vast array of experimental work, the implications of which are developed and argued with extreme acuteness Sometimes, indeed, the authors go beyond what the facts seem to warrant, as in a notable passage (p 296) headed "The Validity of Faraday's Law", and beginning "Faraday's law of equivalent separation naturally holds for the electrolysis of colloidal electrolytes too, provided it is referred to the products separating at the electrodes or escaping as gas On the other hand, it does not necessarily hold for the gel which separates" If the reader, quite reasonably, hopes for even a few instances which permit quantitative verification of the law and would thus provide the most striking evidence possible for the theory, he is doomed to disappointment, since a very detailed discussion of the secondary effects leads to the conclusion that a quantitative verification is scarcely to be expected

Whatever the quantitative evidence, however, it will in the end probably depend on the reader's bias whether he considers that a great attempt to develop a single theory of the constitution of aqueous sols, which excludes adsorption even as an ancillary factor, has succeeded or, indeed, can be completely successful It is certain that everyone seriously interested in the subject will have to study this book, which puts the case for the purely chemical' view with extraordinary ability and, where it becomes controversial, with perfect fairness and good temper

(2) The second edition of Bechhold's well known work appeared in 1918 and was twice reprinted without alterations The present, fifth, edition has been entirely re written, a course which has become unavoidable in view of its purpose, "to apply the results of the investigation of colloids to biology", and the enormous amount of new work done in this field in the last ten years

A short introduction to colloid chemistry forms the first part of the book The second, headed "Biocolloids", deals first with the colloidal constituents of organisms—the carbohydrates, lipoids, and proteins—and then with foods and drinks, enzymes and immunity reactions, giving a clear survey of these subjects in some 80 pages

The third part is probably the most interesting, certainly to the reader who is a student of colloids rather than of biology Assuming what nobody will contest, that living organisms must be built up from colloidal material, the author goes on to say that "Colloid and water in the organism are *one*, an organism free from water is lifeless" It is indeed in this point, the retention, distribution, and elimination of water by organisms, that colloid chemistry has contributed most materially to the elucidation of biological problems It is not necessary to recall how the theory of osmotic pressure was hailed, and even largely developed, by biologists, and how soon it failed to explain things such as—to take one example out of many—the rapid death of marine organisms in pure sodium chloride solutions isotonic with sea water We now know that the water content of organisms or of living tissues is not regulated merely, or even largely, by osmotic equilibria, but also by the specific effects of ions,

effects which manifest themselves equally in the swelling of non living and structureless material like gelatin, and have been investigated largely by this means

How far-reaching are the applications of these experimental results is shown by a very large number of examples under the sub headings dis tribution of materials and metabolism, growth, form and development, cells and tissues, respiration and circulation, resorption, secretion and excretion, and nerves Notwithstanding the large amount of literature drawn upon, the author is not content to give abstracts but always preserves a critical attitude The reviewer (with recollections of papers on " The Viscosity of Protoplasm " in his mind) is entirely in sympathy with the author's strictures on the use of the term to describe the contents of any cell, and with his comment " In looking for the *common* properties of the different protoplasms, one substitutes a uniformity which certainly does not exist, and overlooks the differ ences "

The fourth and last part is devoted to toxicology, pharmacology, and therapy, and to microscopic technique Among many other interesting sub jects it discusses the therapeutic effects of colloidal metals, which still seem to lack a complete explana tion The chapter on microscopic technique gives a good survey of the present theories of staining with due reference to the work of the Prague school

An unusually complete name index and an adequate subject matter index add to the value of the book It should have a stimulating effect on colloid chemists and provide those who have ambitions beyond further investigations on the co agulation of gold or arsenic trisulphide sols with a vast number of fascinating problems

(3) This is a practically unaltered translation of a work published in English under the same title in 1926 and reviewed in NATURE of April 9, 1927, vol 119, p 523 E H

Buckman's Type Ammonites

Type Ammonites VII By the late S S Buckman With Editorial Note, Chronological and other Tables and Index, by Dr A Morley Davies Parts 71-72 (combined) Pp 15-78 (London Thomas Murby and Co, 1930) 20*s*

THE death of S S Buckman has brought to a stop, though not to an end, one of his most remarkable works—those descriptions and figures of Jurassic ammonites, normally from English localities, which began in December 1909 under the title " Yorkshire Type Ammonites " and continued after the War as " Type Ammonites " To how many volumes the series might have extended it is impossible to calculate, so embarrassingly rich is the Jurassic ammonite fauna, and so keen was the discrimination of the author Actually the seventh volume was in progress, and it is now completed by a double part, for which sincere thanks are due to Prof A Morley Davies and his coadjutors, Dr Spath, Dr Trueman, and also Mr Tutcher, who has all along been mainly responsible for the excellent photographs They have performed a laborious task as a memorial to one who throughout his life was a single hearted student of Nature

Both format and form of the work were suggested by *Palaeontologia Universalis*, of which it was originally intended to form part In that work, produced by D P Oehlert and a committee of the International Geological Congress, the essential features were to be a plate referring to each species and bearing a photograph of the type specimen and a reproduction of the original figure, with an accompanying page reprinting the original description and adding such brief notes as might seem necessary Buckman, turning to the type specimens of Young & Bird and Simpson in the Whitby Museum, soon found that more information and discussion were necessary, and rightly judged it more convenient to issue his plates as an independent series As the work progressed, changes were introduced in the method of de scription, important discussions and occasional excursus found their way into the text, new material involved corrections, and, in short, neither the simplicity nor the original plan could be maintained

Prof Morley Davies, therefore, to bring the work to a decent cessation, has here provided a guide to its 1051 plates and its 797 species He has arranged the names of the latter in the order of stratigraphical succession, under hemeræ, and he suggests that the plates might be arranged in a like order, and divided into six volumes The letterpress, with five portraits, would form a seventh volume This list is followed by a list of the plates in numerical order with references to the hemeræ

Then follow an alphabetical list of the 407 genera, with references to plate, page, and horizon, an alphabetic list of trivial names, with references to genus, plate, and hemera, a list of names altered during publication, which, the cynics may be

surprised to learn, amount to only 4 6 per cent, a list of new names appearing first in the text, and an index to ages and hemeræ These and many other notes will make this part indispensable to every user of the work, and subscribers should apply for it without delay

Fresh-water Biology

Life in Inland Waters with Especial Reference to Animals By Kathleen E Carpenter (Text Books of Animal Biology) Pp xviii + 267 + 12 plates (London Sidgwick and Jackson, Ltd, 1928) 12s net

AN introductory work on modern aims and methods in the study of fresh-water life was much wanted, and this book is exactly fitted for the purpose It forms one of the well-known and useful series of Text-Books of Animal Biology edited by Prof Julian S Huxley, who contributes an introduction to this volume The chief object set before the worker is to study the life in inland waters by finding out all that there is to know, not only about the animals themselves and their inter relations with other animals and with plants, but also all that there is to be known about the waters which they inhabit, their physical and chemical nature, geological features, past and present, and how they affect the organisms — in fact, to study the animal thoroughly in relation to its environment

It is often said that life in fresh water has been neglected because of the more attractive life on the sea-shore which is nowadays accessible to almost everyone, but a large amount of excellent and important work has accumulated recently in connexion with fresh water biology, and there is a good foundation laid for research in many fields It is no longer considered sufficient to identify the animals one finds, one must know everything of the life as a whole in each individual area Dr Carpenter is a good field zoologist and her own work has led her to study her subject in this way, therefore she is able to show what is wanted She has produced a real natural history book, attractive and interesting, which will be of much use to all students, supplementing the ordinary text books and courses of study Much that is brought together here can be found only by diligent search in the papers of specialists The bibliographies placed at the end of each chapter are well chosen and contain most of the more important works to be consulted

Perhaps the best parts of the book are the chapters dealing with the biology of streams, rivers, and lakes Here the author is completely at home and the descriptions of the relations and reactions in all groups to so many different habitats make a most interesting whole Fresh water animals are peculiar in offering an enormous number of examples in adaptation, having to withstand numerous and various vicissitudes such as drought, torrents, and differences in physical and chemical constitution of the water in which they live Hence there are hard coated eggs surviving after the death of the parent to burst out into life when better seasons come, or special adaptations for lying dormant either in winter or in summer, special ways of living in rushing streams by clinging tightly to rocks and stones and wonderfully devised apparatus for hanging to the surface film It is peculiarly with insects that such adaptations are at their height and the entomologist has much work before him In spite of all the splendid pioneer work of the older naturalists, whose work still stands as the model of what such work should be, the present-day naturalist has not far to go to find a suitable problem for research He has only to inspect the nearest piece of water, however small, and he will probably find in it some insect the life history of which is unknown A complete survey of the tiniest pond in all its aspects throughout a year can easily occupy many years of work

Apart from the discussions on the dependence of animals on plants as food, the description of the plant life is purposely reduced to a minimum A few plants are, however, mentioned, particularly those in the plankton We should like to know what the author understands by a Peridinian The terms Peridinians and Dinoflagellates are usually regarded as synonymous, but on p 32 we read "Dinoflagellates and Peridinians", and again on p 203, "*Ceratium hirundinella* gives place to and Peridinians", although on p 197 *Ceratium*, *Glenodinium*, and *Peridinium* are given as Dinoflagellates

The last chapter treats of the biology of inland waters in relation to human life, and includes discussions on river pollution, a subject in which the author has herself done good work and which is of ever-growing importance

The illustrations are good, consisting of photographs and clear diagrammatic drawings, the latter perhaps suffering slightly from the roughness of the paper on which they are reproduced This book is recommended heartily to all interested in the biology of inland waters

Our Bookshelf

The Psychological Register Edited by Carl Murchison, in co operation with F C Bartlett, Stefan Blachowski, Karl Buhler, Sante De Sanctis, Thorleif G Hegge, Matataro Matsumoto, Henri Piéron, A L Schniermann (The International University Series in Psychology) Pp ix + 580 (Worcester, Mass Clark University Press, London Oxford University Press, 1929) 27s net

THE difficulties in compiling a "Who's Who" of any kind are twofold first, to decide who shall be included, and secondly, to obtain accurate entries The second difficulty is overcome to a large extent by obtaining particulars directly from the individuals concerned, but, as Prof Murchison remarks in his preface, it is not easy to surmount the language obstacle in dealing with a work which has to cover the whole world The first difficulty, however, is more serious In the volume before us, all full members, and also all associate members with Ph D degrees, of the American Psychological Association, which has high technical requirements for admission, are included For other countries Prof Murchison has had to depend on the nominations of the members of his editorial board, thus Dr F C Bartlett has acted for the British Empire, Dr H Piéron for Latin countries outside Italy, and Dr Z Y Kuo and Dr E Shen have furnished Chinese names

The result of this method of selection—and it is not easy to see how it could have been improved—is that the American entries occupy 296 pages of the book This is, perhaps, not so disproportionate as may seem when the volume of work on psychology carried out in the United States is considered However, the editor is of opinion that other countries are not adequately represented, partly on account of the fact that workers in psychology are often 'labelled' as physiologists, psychiatrists, philosophers, and educationists, and he appeals for additional names in order to make the book truly international in scope

The details given include name, address, date of birth, education and career, and titles of papers (with bibliographies) and published works The entries are arranged alphabetically under countries and there is a name index

Algebraic Geometry and Theta Functions By Prof Arthur B Coble (American Mathematical Society Colloquium Publications, Vol 10) Pp vii + 282 (New York American Mathematical Society, Cambridge Bowes and Bowes, Berlin Hirschwaldsche Buchhandlung, 1929) 3 dollars

IN discussing algebraic curves and surfaces we have the choice of several distinct methods Some authors rely upon Cremona transformations, by which the curve or surface is brought into correspondence with another and simpler curve or surface Others rely upon invariant theory, reducing the geometry to algebra A third school uses parametric representation It is well known how easily the properties of conics are derived by expressing the co ordinates of their points as rational or trigonometrical functions of a parameter For certain cubics, we use elliptic (that is, doubly-periodic) functions When we come to curves of higher orders we need theta functions, which are multiply periodic Some complications arise from the fact that such functions necessarily involve more than one parameter, and are connected by a large number of complicated equations

The special merit of Prof Coble's treatment is that he brings all these various methods into relationship with one another In particular he correlates his own researches, developed by means of Cremona transformations, with those of Schottky, who uses the theta functions as a starting point There are also references to apolarity and a few of the simplest ideas of the theory of groups No thorough treatment of advanced algebraic geometry can be easy reading, but Prof Coble has done as much as possible to smooth our path

H T H P

Dipolmoment und chemische Struktur Herausgegeben von Prof Dr P Debye (Leipziger Vortrage, 1929) Pp vii + 134 (Leipzig S Hirzel, 1929) 9 gold marks

REVIEWS have recently appeared in these columns (NATURE, Jan 4, p 9) of Prof Debye's book on polar molecules, and of a translation of this work into German, which has the additional merit of including an up to date list of values of this important constant The present volume deals with the same topic, and has been compiled under the inspiration of the same author, but it has taken a different form, since it includes within its covers thirteen contributions by nine authors in reference to dipole moment and chemical structure One of the contributions (from an American worker in Brussels) is in English, the remainder are in German, but include papers from laboratories in Zurich and Copenhagen, as well as Hamburg, Wurzburg, Freiburg, Karlsruhe, and Leipzig The volume will be read with interest by those who are in a position to make use of one of the most important methods of deducing the structure of molecules from their physical properties

Vorgeschichtliches Leben in den Alpen Von Leonhard Franz Pp 95 + 23 Tafeln (Wien Anton Schroll und Co, 1929) 6s

THIS book, the author explains, has been written for lovers of antiquity and lovers of the Alps It is a popularly written account of the prehistory of Switzerland from the earliest times of which traces have been found—"Die Zeit der Barenjager", as the author puts it—down to the end of the iron age While it is intended primarily to interest the visitor to the country in its prehistoric antiquities, it will be found a convenient summary of information scattered in various publications The lake villages naturally are treated in some detail The book is illustrated by 82 well selected photographs and drawings

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

The Radcliffe Observatory

I HAVE been requested by the National Committee for Astronomy to forward the accompanying copy of a resolution adopted *nem con* by the Committee at a meeting held on May 9

" In view of the large number of astronomical observatories already existing in the northern hemisphere in indifferent climates, where many important types of observational work cannot usefully be attempted ,

" And in view of the great need for comprehensive investigations in the southern hemisphere with powerful equipment ,

" And in view of the stations in the southern hemisphere already erected, or in course of erection, by several foreign observatories ,

" And fearing the danger of British observational astronomy permanently losing its position in the front rank unless greater use is made of the best climates in the British Empire ,

" The National Committee for Astronomy is of opinion that the establishment in South Africa, under English control, of a new observatory equipped with a large reflector, and adequately endowed, would not only be in the best interests of astronomy, but is almost an imperative necessity in the interests of British scientific prestige

" Such an observatory, if established, would be able to carry out work in the southern hemisphere complementary to that of the Dominion Astrophysical Observatory in British Columbia, which has so signally justified its erection

" Further, the Committee, being aware of the proposed transfer of the Radcliffe Observatory from its present site, is strongly of the opinion that the opportunity should be taken to move the observatory to South Africa rather than to another site in England, and that such a project would be an enterprise of national importance

" The Committee feels confident that if this scheme were adopted, not only would new fields be opened up, but existing facilities would be greatly improved, in particular by co operation between the Oxford University Observatory and the Radcliffe Observatory , and that this co operation would be of much greater value to the study of astronomy in Oxford if the Radcliffe Observatory were transferred to a site in South Africa than if it remained in England "

Of the seventeen members of the Committee who were present when the vote was taken, the following voted in favour of the resolution

A Fowler (Chairman), Yarrow research professor of the Royal Society and professor of astrophysics in the University of London (Imperial College), A C D Crommelin, president of the Royal Astronomical Society , C R Davidson, Royal Observatory, Greenwich , Sir Frank Dyson, Astronomer Royal , A S Eddington, Plumian professor of astronomy, University of Cambridge , J Evershed, lately director, Kodaikanal and Madras Observatories , J Jackson, chief assistant, Royal Observatory, Greenwich, H Knox Shaw, director of the Radcliffe Observatory, Oxford , W J S Lockyer, director of the Norman Lockyer Observatory, Sidmouth , E A Milne, professor of mathematics, University of Oxford , H F Newall, lately professor of astrophysics and director of the Solar Physics Observatory, University of Cambridge , Rev T E R Phillips, lately president of the Royal Astronomical Society , Lord Rayleigh, emeritus professor of physics, Imperial College of Science and Technology , R A Sampson, Astronomer Royal for Scotland , F J M Stratton, professor of astrophysics and director of the Solar Physics Observatory, University of Cambridge , H H Turner, Savilian professor of astronomy, University of Oxford

A FOWLER
(Chairman of National
Committee for Astronomy)

Imperial College of Science and Technology,
London, S W 7, May 16

Quantitative Analysis by X-Rays

IN their interesting letter to NATURE of April 5, p 524, Prof T H Laby and Mr C E Eddy agree with many of the statements in my address to the British Association, but dissent in some respects from my conclusions According to their view, I was not sufficiently generous in stating the sensitiveness of the method The sensitiveness depends on numerous factors such as the energy applied, the time of exposure, the wave lengths to be photographed, and so on, and in a very high degree on the constitution of the sample , traces of copper present in aluminium will give an X ray line incomparably stronger than when present in the same atomic concentration in lead The state of aggregation of the sample is also of great importance , an alloy available in comparatively large amounts, which can be soldered massively on to the anticathode, and, on account of its high heat and electrical conductivity, can be bombarded very intensively by cathode rays, is much better than a sample of mineral possibly available in minute quantity only, which must be rubbed as a powder into the anticathode

As the sensitiveness is to a high degree dependent on the conditions mentioned, no exact figure covering all cases can be quoted , the determination of an element present to the extent of 1 in 10,000 is possible in many cases, and in some special ones lower concentrations still can be determined Prof Laby and Mr Eddy achieved much greater sensitiveness in their analyses than this, and they are to be congratulated on the excellent results they obtained in the analysis of copper or iron in zinc I must, however, entirely disagree with their statement that the entire X ray spectrum of an element can be obtained even at concentrations less than 0 0001 per cent If they try to determine traces of sodium in lead they will certainly encounter very great difficulties even at so high a concentration as 1 in 10,000, and if they try to analyse most mineral samples, they will scarcely be able to attain the accuracy claimed

As the intensity of an X ray line is closely dependent on the constitution of the sample, it cannot be considered an exact measure of the amount of the element present , but if a suitable reference substance be added to the sample and the assumption made that the line emitted by the latter is influenced by the presence of different elements in exactly the same way as the line of the element to be determined, then a comparison of the intensities of the two lines can be employed as a method of quantitative analysis It is only necessary to know the amount of the reference substance added and the intensity ratio of the two lines emitted by equal numbers of atoms of the two elements, which can be empirically determined

While it is convenient to compare lines of equal intensity, partly because a microphotometer is then no longer essential and partly because some of the

disturbing effects are minimised, the method is in no way restricted to these cases In some very special cases an addition of reference substance is not necessary as it is already contained in the sample to be investigated and such special cases were investigated by Prof Laby and Mr Eddy, but this method is of very restricted application and will fail in the whole domain of mineral analysis, and also in many cases of the analysis of alloys The chief field of quantitative X ray spectroscopy, however, is not those alloys which can easily be analysed by chemical methods, but the large domain of mineral analysis where the tedious processes used to dissolve the mineral can be avoided and the great difficulties with elements like niobium, tantalum, and the rare earths, and so on, can be circumvented So far as alloys are concerned, cases like the determination of traces of tungsten in steel or of iridium in platinum might be included

The success of the analysis depends greatly on the suitable choice of the reference substance As mentioned above, we have to assume that the line emitted by the reference substance is influenced in exactly the same way by other constituents of the sample as the line to be investigated If the reference substance is not chosen accordingly, this condition is far from being fulfilled When determining chromium ($K\alpha_1$ 2285 X U) the praseodymium $L\beta_1$ line (2254 X U) is a suitable reference line, but should comparatively large amounts of vanadium be present, the analysis will give a wrong result, as the absorption edge of vanadium (2265 X U) is situated between the two above mentioned wave lengths and as only praseodymium can excite the *K* spectrum of vanadium, a selective weakening of the praseodymium line will take place It was found that the presence of 4 atoms of vanadium to each atom of praseodymium alters the intensity ratio by 63 per cent

When nickel is compared with cobalt in the presence of a large excess of copper, the intensity ratio of the nickel and cobalt lines will be shifted in favour of the cobalt line, as only the cobalt edge can be excited by the copper lines We have here a case of another group of disturbing effects, namely, where strong emission lines of elements present in large amounts are situated between the absorption edge of the element to be determined and the absorption edge of the reference line In a paper in print for the *Zeitschrift für Physik*, a complete list of reference substances is given for all elements between sodium and uranium and the limitations in each case

Apart from the disturbances mentioned above, an entirely different kind of disturbance can originate from the fact that under the influence of the cathode rays a change in the composition of the mixture takes place When investigating a mixture of refractory oxides these disturbances are scarcely noticed Nor have such been noticed by Prof Laby and Mr. Eddy when analysing alloys—their alloys being soldered to the anticathode and having high conductivity for heat and electricity, this can easily be understood But when analysing minerals or chemical compounds, especially those containing components of fairly high vapour tension, very appreciable errors can be introduced To avoid these errors (which were first systematically investigated by Coster and Nishina, and whose work was corroborated and extended by Glocker and Schreiber), it is advisable in such cases to abandon the excitation of the X ray spectra by cathode rays and to excite them instead by X rays and investigate the secondary X ray spectrum

While in special cases such as the one so successfully investigated by Prof Laby and Mr Eddy, methods can be developed where the addition of a reference substance can be dispensed with, only those in which an added reference substance is employed can claim general applicability

G HEVESY

Physikalisch chemisches Institut,
Freiburg im Breisgau,
April 26

Fine Structure of *K* Absorption Limit of Silicon Oxide

THAT the X ray absorption limits are not simple but show a rather complicated structure has been known now for some time The main difficulties in their experimental investigation are in respect of (1) amount of the absorbing substance, and (2) dispersion of the spectrograph The amount of the absorber must not be either too great or too small, otherwise the details are lost Secondly, the dispersion must be made as large as possible to bring out all the details and measure them with the usual accuracy

Fricke investigated *K* absorption limits of some of the lighter elements (*Phys Rev*, **16**, 1920) He could not get any absorption limit at all for silicon This was probably due to his using very thick absorbing screens coupled with the low dispersion which he obtained with sugar crystal Later Lindh (*Zeit für Phys*, **31**, 1925) succeeded in obtaining the *K* absorption limit for silicon both pure and in chemical combination, but no fine structure was seen in any case

Recently in this laboratory I made an attempt to obtain fine structure of the *K* absorption limit for silicon oxide without the use of an extra absorbing screen, the analysing quartz crystal itself acting as the absorber This was done at the suggestion of Prof Siegbahn, to whom I am highly indebted for it The vacuum spectrograph used was one of the latest models of Prof Siegbahn's design made in the laboratory workshop The continuous radiation was obtained with tungsten as the anticathode material The tension at which the X ray tube was worked was kept suitably low and the current density was pushed up as much as possible The rather long exposures of twenty to twenty four hours were amply

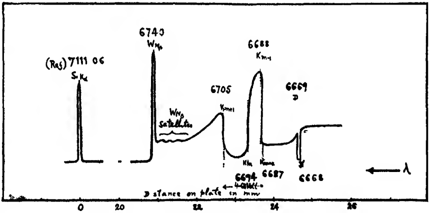

FIG 1

repaid by the extended fine structure of the K-limit of quartz recorded on the plate The blackening of the photographic plate is shown diagrammatically in Fig 1, which also gives the wave lengths in X U of the several edges

It is interesting to note that the white line between D and D' is only 0 054 mm wide, while the width of the slit was 0 091 mm Still farther to the right of DD' there are two more such lines As, however, owing to feeble intensity, their measurement is uncertain, they are not shown in the diagram From the nature of these lines it appears that they are not components of the K-absorption of silicon oxide an explanation of them must be sought in the geometry of the atomic planes of the quartz crystal The discontinuity at DD' recorded on the photographic plate arises, as Fig 2 shows, in the process of division of the incident energy I corresponding to wave-length λ into two parts, one, I_a, regularly reflected towards the photographic plate by a system of atomic planes A (l, m, n), and the other, I_t, simultaneously reflected inwards by another system of atomic planes B (l', m', n') Similar light lines having the appearance of absorption lines were observed with rock salt by Wagner (*Phys Zeit*, **21**, p 632, 1921), O Overn (*Phys Rev*, **16**, 1920, and **18**, 1921) and later on by Berg (*Naturwiss*, **14**, 1926), who extended the observations to other cubic crystals Their origin was explained on the lines indicated above

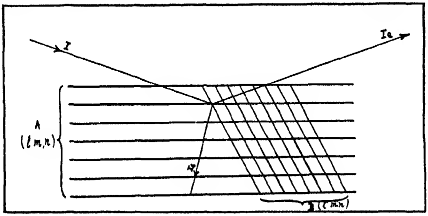

FIG 2

Finally, it may be mentioned that the value of the K absorption edge for silicon oxide as given by Lindh is 6707 5 X U, but the edge was not much separated from the rather intense tungsten $M\beta$ line registered on his plates

A detailed account of the above will be published elsewhere G B DEODHAR

Physical Institute,
University of Uppsala, Sweden,
April 4

The Parachor and Molecular Volume

DR FERGUSON's letter in NATURE of April 19 is a little difficult to follow At first he agrees with me that the parachor is a comparative measure of molecular volume "at temperatures such that the surface tensions are equal", yet later he says emphatically that "it is certain that the parachor is not a molecular volume"

It is evident that the term "molecular volume" must here be used in two different senses The most direct significance of this expression is the actual volume of N molecules (where N is Avogadro's number) Our knowledge of the dimensions of molecules is, however, very limited and is mainly based on collision areas deduced from gas viscosities, to convert these into volumes involves hypotheses concerning the shape of the molecule and thus introduces large uncertainties From the time of Kopp it has been assumed, implicitly, or explicitly, by many writers that the volume *occupied* by a gram molecule of the substance in the liquid or solid state under some standard condition is a measure of the volume of the molecule Comparisons of such molecular volumes have been made for the volumes occupied at absolute zero, at 0° C, at the boiling point, and at the critical temperature, hence when I used Macleod's equation to calculate the volumes occupied by liquids at constant surface tension I did not (and still do not) consider it unjustifiable to regard the result as a measure of molecular volume

The relation between the parachor and the critical volume was never put forward as an accurate physical law but as a rough test of the view expressed above Dr Ferguson's relation is undoubtedly more accurate, it is interesting to note, however, that as the complexity of the molecule increases, V_c and θ_c increase together in such a way that the ratio $V_c^{1/6}/\theta_c^{1/4}$ involving small fractional powers of these quantities is nearly constant Hence except for hydrogen and helium both my relation and Dr Ferguson's hold with fair accuracy I am indebted to Dr Ferguson for correcting my blunder with regard to the critical volume of hydrogen, both this gas and helium give a ratio of P/V_c which is much smaller than that given by most other substances

I gather from Dr Ferguson's letter that he considers the critical volume to be the most significant of all the molecular volume constants I have endeavoured to test this point by a comparison of molecular diameters deduced from gas viscosities with those calculated from parachors and from critical volumes (*Jour Chem Soc*, 1055, 1929) Spherical molecules and close packing are assumed and these hypotheses lead to considerable uncertainties The following data are taken from this paper σ_c and σ_p represent the diameter of the sphere occupied by the molecule at the critical temperature and at unit surface tension (parachor) The ratios of these quantities to σ_η, the molecular diameter obtained from viscosity measurements, are given in the last two columns

Substance	σ_η	σ_p	σ_c	σ_p/σ_η	σ_c/σ_η
Hydrogen	2 18	4 34	5 33	1 99	2 44
Helium	1 94	3 61	5 12	1 86	2 64
Neon	2 32	3 88	4 60	1 67	1 98
Argon	2 90	5 01	5 73	1 73	1 97
Chlorine	2 18	6 38	6 61	1 55	1 60
Bromine	4 12	6 75	6 81	1 67	1 69
Hydrogen chloride	4 04	5 41	5 93	1 85	2 02
Benzene	4 20	7 84	8 42	1 87	2 01
Propyl Acetate	4 67	8 42	9 31	1 80	1 99

It will be seen that the critical volumes of helium and hydrogen give abnormally high values for the ratio σ_c/σ_η, whilst the ratio σ_p/σ_η based on the parachor for these substances is more nearly in agreement with

that found for more complex molecules This may be due to the unusually large forces between the molecules of hydrogen and helium due to the presence of two electrons only in the outer shell, in most other substances the outer shell of each atom contains eight electrons and the intermolecular forces are correspondingly modified Hence the parachor, in which some attempt is made to allow for the effect of internal pressure on the volume occupied by a gram molecule of a liquid gives a rather better parallelism with the viscosity data than does the critical volume The uncertainties involved in the data and in the hypotheses used in the calculation of diameters are large and must be borne in mind when attempting to interpret the ratios given in the last column of the table The abnormality of the critical volumes of hydrogen and helium is, however, so great that I think it must be regarded as real

S SUGDEN

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A Method of obtaining Stages in the Life-history of the Liver Fluke for Class Purposes

THE life history of the liver fluke (*Fasciola hepatica*) was described by A P Thomas in *Q J M S*, Lond, vol 23, N S, 1883 He succeeded in rearing experimentally the early stages of the complicated life history of this parasite by collecting eggs from the gall bladder of sheep bringing about their hatching under suitable conditions, and infecting the molluscan host, *Limnæus truncatulus*, from which he obtained both rediæ and cercariæ, using the latter for the infection of young lambs His methods, however, are not suitable for class demonstration owing to the difficulty nowadays of getting the eggs of the fluke from heavily infected sheep

During the past two years I have used a simpler method It is generally possible to obtain from the local abattoir a few specimens of adult flukes either alive or dead The flukes should be washed free from bile and mucus Each specimen is then dissected under the Zeiss binocular dissecting microscope and the contents of the uterus emptied into a flat bottomed watch glass Some of the eggs will be yellow in colour and are suitable for hatching experiments, others are white and should be discarded The yellow eggs sink to the bottom of the water, and when a sufficient number have been extracted, the fluke tissues and clouded water are pipetted off Repeated washing leaves the eggs in a clear fluid The development of the eggs can be studied under the microscope from day to day Every few days the water should be changed Warning of the hatching of the eggs is given by the appearance of cilia and of the X-shaped eye spot At first the young embryo squirms up and down within the egg shell, but about the last day before hatching it turns round as if trying to find the exit The period of development varies with the temperature, in spring it is about a month, but is less in warmer weather The eggs hatch in batches in the morning and the larvæ are phototropic By the same evening all are dead unless they have found a host

As soon as possible after hatching, a specimen of *Limnæus truncatulus* is introduced into the dish In a short time it acts as a focus around which the miracidia swarm The actual penetration can be watched under the Zeiss binocular Large numbers of the larvæ fix themselves to the tentacles, head, and mantle of the snail, so that the unfortunate and apparently unconscious mollusc is bristling with white threads, which show up well against its dark skin As many as sixty were counted on one snail, and this does not include those which entered the pulmonary chamber and were lost to view The larvæ bore like screws, and take from fifteen minutes to an hour or more to disappear within the snail

Specimens of *Limnæus* preserved at this period and afterwards sectioned show the miracidia entering the body, while snails killed after an interval of two or three weeks exhibit the sporocyst and redia stages Many of the miracidia do not develop, Thomas says they must enter the pulmonary chamber or body cavity and that they do not develop in the foot I have, however, found them in the kidney, dorsal body wall of the head and sides of the foot Thomas also states that few snails survive three weeks of artificial infection, but I have had no deaths as the result of infection, however heavy Snails were infected this year on Mar 11, and are still alive and active

N B EALES

Zoology Department,
University of Reading,
May 3

Parasitism in Relation to Pupation in *Lucilia sericata* Meig

IN NATURE of April 19, p 598, Holdaway and Evans make reference to the stage in which the hibernation of *Lucilia sericata* Meig takes place Their observations show that although "both larvæ and puparia were recovered from the soil surrounding baits exposed in the autumn and examined towards the end of the season", that 87 4 to 92 2 per cent of these puparia (plus larvæ pupated within eight days of collection) were parasitised From these facts it is evident that in Toulouse, France, from which station the letter is addressed, the normal mode of hibernation of *Lucilia sericata, excluding the influence of parasitism*, is in the larval stage, and thus is similar to that found by me in North Wales in 1928-1929 (NATURE, May 18, 1929, vol 123, p 759) In the latter case, and again last winter, when observations on the hibernation of *Lucilia sericata* have been confirmed, not a single puparium appeared among the hibernating larvæ

This fact at first appears striking, since Holdaway and Evans found hibernating puparia which did not yield parasites It should, however, be noted that I was dealing with larvæ obtained direct from living sheep, and not with larvæ from exposed baits as was the case in the work of Holdaway and Evans It proved very significant that from the 5622 larvæ obtained periodically from living sheep during the survey in the summer 1928, and from the many batches of larvæ obtained from similar sources throughout the summer 1929, no parasite was bred This fact no doubt explains the absence of stimulated pupation among the hibernating larvæ, and thus, as negative evidence, supports the observations of Holdaway and Evans that pupation among hibernating larvæ is stimulated by parasitism

Further, the complete absence of puparia among these non parasitised hibernating larvæ upholds the view that in the observations of Holdaway and Evans the puparia present which did not yield parasites had been previously stimulated to pupate by a secretion or other factor operative during the oviposition of the parasite, which oviposition had been non productive

The absence, or the extraordinary rare occurrence, of parasitism among larvæ of *Lucilia sericata* obtained from the living host will, no doubt, prove an important factor in the success of *Alysia manducator* Panz in the biological control of blow flies The living sheep will obviously be a constant and important source of unparasitised larvæ The reason for this immunity cannot be the absence of the parasite from the

localities from which the larvæ were obtained for specimens of *Alysia manducator* have been observed in quantity near carrion in several districts in North Wales On the other hand, it is well known that the primary attraction of this parasite is the chemotropic action of carrion, hence it would appear that a live sheep attacked by larvæ of *Lucilia sericata* offers no attraction for ovipositing females of *Alysia manducator*, and thus the larvæ in this environment escape the attacks of the parasite

W MALDWYN DAVIES

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Bangor

Coloured Glass as a Deterrent to House Flies

LAST autumn we received an inquiry from Mr L Macqueen Douglas, of Newpark, Mid Calder, Midlothian, who asked us whether we had any data concerning the action of coloured glass on house flies In his experience coloured class, especially blue, acted as a deterrent, and he was using it in the construction of abattoirs, etc At that time we were unable to obtain any further information upon the subject On the appearance in NATURE of April 5 of the letter from Messrs Pilkington Bros , who stated that red and yellow are the best deterrents and that blue and green are not nearly so effective, I communicated these facts to Mr Douglas He replied stating that he had carried his experiments somewhat further, and that from his experience blue glass is to be preferred to yellow for two reasons First, he found that the blue glass was completely effective in preventing the development of flies , and secondly, that the blue glass does not give an offensive look to the meat, while yellow glass gives it an unhealthy looking colour which from a commercial point of view is highly objectionable

I might add that Mr Douglas's experience of abattoirs and their construction is very extensive

A D BUCHANAN SMITH

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University of Edinburgh, May 1

MESSRS PILKINGTON BROS , in NATURE of April 5, raise an interesting point regarding house flies and their dislike of light of certain hues The following observations, made during September of last year, may be of interest

Two similar small rooms were roof glazed, one with ordinary rolled plate, the other with a proprietary heat absorbing glass transmitting bluish green light Ventilators in the two rooms gave insects equal opportunities for ingress, but at the end of a fortnight the numbers of insects in the rooms were so obviously unequal that a count was made, with the following result

Type of Insect	Under Clear Glass	Under Bluish Green Glass
Flies	19	8
Moths	4	1
Wasps	4	0
Spiders	3	0

It should be added that, during hot weather, the maximum air temperature in the room glazed with rolled-plate was usually 5° or 6° F greater than that in the other room There was also a marked deficiency of infra-red radiation beneath the bluish green glass which may partly account for the results obtained

H. E BECKETT

Building Research Station,
Watford

Nutritive Value of Elm Tree Bark

IN the water meadows opposite my home in Chalfont St Peter several elm trees were blown down by last winter's gales The horses and cows grazing on these meadows spent much of their time in chewing off the bark of the boughs of the fallen trees, although there was abundant young grass growing on the meadows all through the last months of a mild winter

Interested by this fact, I put two lots of seven mice, just weaned from well fed, healthy mothers of known stock, on a diet of white bread and water, and to one lot I gave some elm tree twigs every few days The mice gnawed the bark off the twigs At the end of seven weeks these mice had gained 45 gm , while the control lot had gained only 22 gm in weight X-ray photographs showed no difference in the lines of ossification of the bones in the two lots, so that the bark was not eaten for the sake of vitamin D This might be thought to be deficient in winter grass owing to the low intensity of the short ultra violet rays of the sun The fur of the mice which ate the bark had a sleaker appearance

LEONARD HILL

Ionisation in Nitrogen

EXPERIMENTS on corona discharge in carefully purified nitrogen at low pressures show that the mobility of the negative carriers is much lower than that found for electrons by Townsend and Bailey (*Phil Mag* , December 1921), as is shown by the following table

X/p	ωp	
From 10 to 40	$4\ 4 \times 10^5$	Townsend and Bailey
25	$12\ 9 \times 10^4$	Corona Experiments
20	$9\ 0 \times 10^4$	,,
15	$5\ 7 \times 10^4$	,,

X = electric force in volts per cm
ω = mobility in cm per sec per volt per cm

Since Townsend and Bailey's experiments show that electrons retain their high mobility for a considerable time, the carriers cannot all be electronic The greatest possible proportion of electrons present varies approximately linearly from 0 025 when X_0/p (at the surface of the inner cylinder) is 350 to 0 012 when X_0/p is 200

J H BRUCE

Electrical Laboratory,
Oxford, April 23

Undercurrents in the Strait of Gibraltar

IN view of the lively discussion of the undercurrents in the Strait of Gibraltar during recent years, some observations made by H M Surveying Ship *Goldfinch* (Lieut Commander F H Walter) in 1905 with the Pilsbury Current Meter, where I was serving as Senior Assistant Surveyor, may be of interest They were not published, since they were not taken under good conditions, but they are amply sufficient to show that at a position N 53° W (True), 7 miles from Cape Spartel, the current between the surface and 200 fathoms was easterly and weak , below 200 fathoms it began to turn to the west, and observations between 250 and 290 fathoms showed currents of more than 5 knots flowing nearly west True It is hoped that it will be possible to publish the observations in full, shortly

H P DOUGLAS
(Rear-Admiral, and
Hydrographer of the Navy).

Hydrographic Department,
Admiralty,
London, S W.1,
April 17

Josiah Wedgwood and his Influence on the English Pottery Industry

By S R HIND

IN order to understand the state of the pottery industry of Britain at the time Wedgwood took up his labours, it is necessary to go back to a period some forty years before his birth in 1730 At this time the products of the Staffordshire potteries consisted of heavy, coarse ware made of local clays in the form of platters, drinking and cooking pots, butter pots, and similar articles These were crudely made, usually on the potter's wheel, ornamented in an elementary way, if at all, and glazed imperfectly by means of raw lead preparations such as galena

One great exception, indicative of the change to come, must be made on behalf of the secret manufactory of the brothers Elers, natives of Nuremberg, who had come over from Amsterdam and developed a new kind of ware at Bradwell Wood, near Burslem They manufactured a fine red stone ware out of carefully prepared local clay, the articles being lathe turned whilst partially dry, ornamented with applied designs of sharp outline, and finally salt glazed These new methods ultimately became diffused in the neighbourhood, with some loss in effect for the time being, but an enormous stimulus to progress, by the efforts of the elder Astbury

Astbury's use of washes of finer clays marked the beginning of a line of development which led to various forms of ornamentation, engobes, and glazes of composite and infinitely superior character The uses of various lead compounds, feldspar, borax, and other glaze components began to be explored and their qualities modified by a preliminary fusion or fritting

The advantages of flint in admixture with both bodies and glazes soon came into prominence Its preparation by dry grinding, following calcination, led to many cases of what we know now as silicosis, this danger was reduced very markedly by a painter named Benson, who introduced the wet grinding process Later improvements in the application of water and wind power and the use of mill runners of chert, a fairly pure form of silica, in place of granite, take us down to the early careers of Brindley and Wedgwood

Other notable advances were in connexion with plaster of Paris moulds, the use of the red clay colour trials of Thomas and John Wedgwood in controlling the firing of ovens, an increasing appreciation and importation of ball clay and pipe-clay from the south of England, the use of the slip kiln, and the introduction of biscuit firing (that is, separate firing of the body before application of the glaze) by Enoch Wood, this at a time when Wedgwood had already launched out in his early partnership with Harrison and Alders

By this time, a coarse cream earthenware, white or greyish-white and red stoneware and tortoiseshell ware, were the staple of the district The field was set for great advances, but the master-hand was lacking, and trade was even declining, owing to the competition of Delft or Dutch enamelled pottery, which was being imported in large quantities in 1759, the year in which Wedgwood commenced operations as a master potter

So much, as the briefest of summaries, must serve as an indication of the outward circumstances in which Josiah Wedgwood commenced his great work A few details as to his early life will serve as a slight guide to his reaction to these conditions Born the thirteenth child of a master potter in modest circumstances in Burslem, he received such education as could be obtained in the local schools This, however, only lasted until his tenth year, when his father died and he was put to work as a potter under his eldest brother Thomas He appears to have had the instincts of an artist and a craftsman even at this early age, and became a proficient thrower A violent interruption in the form of an attack of virulent smallpox laid him low after two years and this left after-effects, notably a weakness in the right knee, which ultimately led to the amputation of his leg Returning to work, he soon found that he could not continue 'throwing,' and had to turn his mind to other branches of the work The variety thus enforced, coupled with the suffering and meditation incident on his illness and its after effects, must have assisted the godly discipline of his mother in developing a noble and imaginative character, whose great and indeed sole objective was to excel in his craft

Wedgwood's mind having a strong experimental bent, and his brother having no desire to widen the scope of his manufactures, Josiah at the close of his apprenticeship threw in his lot with Harrison and Alders, owners of a small pottery, and later with a more progressive potter named Whieldon of Fenton Low Even this period was not uninterrupted by illness, which only appears to have tempered the true steel of the young potter, and left his energies unabated By now (1759) he had studied every branch of the manufacture of ordinary pottery and even its sale, being impatient of further restriction, he commenced business at the Ivy House, Burslem, having engaged a second cousin, Thomas Wedgwood Thomas had previously been a potter at Worcester and afterwards became his cousin's partner in the manufacture of 'useful' ware, chiefly the improved cream ware. The business grew rapidly, potters were trained to the improved methods, and by 1763 the need for increased accommodation had become so pressing that Wedgwood took over the Brick House Works (Bell House), Burslem His close application to every detail of manufacture, improvements resulting from constant experiment and subdivision of labour, resulted in what, in those days, was nothing less than mass production

Having established his manufacturing unit on sound lines, Wedgwood now turned more and more of his attention to organising his connexion with

the outside world An illness due to a further injury to his leg on the way to Liverpool led to a long stay in that town and a friendship with Thomas Bentley, out of which developed a partnership which relieved Wedgwood of a great part of the exploitation of his wares Bentley gradually transformed his business from that of a general merchant and exporter to that of pottery merchant solely Wedgwood and Bentley ultimately went into partnership in ornamental wares The latter transferred to London and supervised the sales of Wedgwood ware in the Court circle, also managing an extensive decorating works in London He secured artistic and other services and was a constant friend and adviser to his partner on almost every phase of the joint enterprise

At this period Wedgwood entered into arrangements with Sadler and Green of Liverpool, with respect to the printing of outlines of on glaze decoration according to the transfer method de vised by Sadler These outlines were afterwards filled in by hand The method was later extended to include the whole decoration Sadler and Green also possessed enamel kilns of their own for fixing such decoration, and did a thriving trade by buying ware, particularly from the Liverpool potteries, decorating it and reselling

By the time these developments had taken place, Wedgwood's improved cream ware had become an important article of commerce, restored the export trade of Great Britain in pottery and been accorded Royal patronage, in honour of which it was henceforth known as Queen's ware A further expan sion of accommodation was necessary, resulting in the purchase of a new site, and the erection of what was then a model factory and village at Etruria, near Hanley The Burslem potteries were still retained

Wedgwood had also meanwhile been actively engaged in the improvement of local conditions, notably in taking a prominent part in the develop ment of means of road and canal transport, and he reaped the benefit in the then ideal situation of his new works

A new era of prosperity now opened up The cream ware attained the height of its perfection Exports to every part of Europe and to America continued to grow Catherine II of Russia commissioned the manufacture of a stupendous set of table ware amounting to 952 pieces A large number of these had to be specially modelled, and the plates and dishes were embellished, besides the normal rim decorations, with hundreds of paintings of English castles and mansions Great use was made of the camera lucida in securing these views It is doubtful whether this form of ornamentation can be considered to be in keeping with Wedgwood's excellent and restrained taste in decoration, but as a work of art, largely intended for show purposes, the set was certainly a wonderful achievement A number of pieces corresponding to those of the set were also made for other purposes, but without the frog badge which was ordered as part of the original decoration

Wedgwood's service to English pottery went much further than such improvements in serviceable ware as have been touched upon He saw possibilities in ceramic products, of elevating the whole tone of artistic appreciation in the country and abroad In his jasper body, a unique composition requiring great skill in manufacture, but yielding the finest results, he saw the possibility of reproducing works of art at a cost which would render their wide dissemination a practical proposition Ceramics was to become to the arts as the invention of printing to the sciences Space will not permit of any but the briefest reference to the lines this development took

Excellent books exist to show the success he achieved Wedgwood concentrated on every available source of artistic material, books of drawings from the antique, collections of cameos and gems, and the original works of a large number of artists, amongst whom Flaxman, Hackwood, Webber, and Tassie are pre eminent

The black basalt body had been improved to the point of making it an admirable medium for busts and vases The jasper body, normally translucent and white, a delicate body of which the chief con stituent was cawk or barium sulphate, was controlled as to translucency, the special difficulties encountered in its firing were overcome after lengthy experiments, and blue, green, yellow, lilac, and black bodies were prepared from it by suitable additions of colouring oxides , and their agreement with one another in firing shrinkage ensured

The moulding of cameos, first with plaster moulds, was replaced by the use of the technically more perfect, but more troublesome moulds of fired clayware, and ultimately the finest results in coloured backgrounds were attained by the substitution of coloured washes or engobes for the solid coloured bodies The use of the improved lathe was called in to add fluting, chequer, and other effects The principal uses to which the new combination of materials and technique were put, lay in bas relief ornament on ornamental ware of all descriptions, portrait cameos, medallions, vases, plaques, and panels for fireplaces and cabinet-work The most famous, if not notorious, application lay in white jasper ornaments on the famous cobalt blue ground Perhaps the most beautiful to the modern eye are the few existing examples of low relief classical ornament in white on the white ground Undoubtedly, the most remarkable and difficult examples are the copies of the Portland or Barberini Vase

A few words, even in such an incomplete account as this, must be devoted to Wedgwood's association with the scientific men of his day Throughout his life he maintained as close a contact as possible with the progress of chemical and physical science He was a regular correspondent with Priestley and Darwin (Wedgwood and Darwin were both grandparents of Charles Darwin), and well known to the fraternity of the Royal Society, to which he was elected for his clay shrinkage pyrometer This was developed out of his experiments on controlling the heat in his ovens, and it remained for long unrivalled for the purpose

Josiah Wedgwood made notable contributions

to our knowledge of glazes, colours, decorations, saggars, and in fact practically every department of pottery manufacture It must be admitted that the times and conditions to which he was born conspired together to favour a rapid development of the pottery industry, and that other men of his day, Spode and Turner, for example, also made worthy contributions to that development Nevertheless, it is clear that he was their acknowledged leader and a man of the greatest generosity and natural ability

He died in January 1795 after a life dogged by ill health, but inspired to the last with the creative enthusiasm of his craft

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The Importance of Cataclasms in Evolution *

By Dr G P BIDDER

A CATACLASM is the result of an exceptional drought, flood, heat, cold, volcanic disturbance, or change in constituents of atmosphere or ocean, or other change in environment which over a large area is fatal to all species or individuals saving those which are exceptionally provided, quantitatively or qualitatively, so as to survive the ordeal This definition is in strict agreement with Southey's use of the word in 1834 (Oxford Dict) We may consider the essential phenomenon of a cataclasm as the reduction, by some violent happening, of a populous region of earth or sea to sterile emptiness, which is repopulated by the few survivors of the disaster † Destruction may come upon all living beings from a volcano, or from a volcanic wave upon land and freshwater organisms, or from a pandemic disease upon only a single group of animals

Darwin recognised the importance of the cataclasm, but he rarely emphasised it, probably because diluvial doctrines had so long held the field It is now generally overlooked in theoretical discussions The possibility of a given species character or individual variation having survival value is commonly discussed from the point of view only of normal environment, without recognising that eschatological environment has equal or greater importance in the selection of races, and in regard to many characters must have been the only decisive factor

If a small heritable quantitative or qualitative difference can lead to the survival of an individual in a catholic danger which destroys all individuals of the species not endowed with such a difference, then, though the danger recurs but once in 50,000 years, that difference must eventually be stereotyped as a character of the species In the intervening 50,000 years of peace many successful variations may take place which do not include this saving difference, but they are pruned by the next similar cataclasm, the survivors of which will again all conform to type Thus cataclasmic selection may enforce specific characters which are normally useless

The position may be illustrated by considering at length the brief argument on the giraffe's neck in the sixth edition of the "Origin of Species", recalled to notice by Pycraft's interesting essay in *Science Progress* for January last Darwin says "The individuals which were the highest browsers and were able during dearths to reach even an inch or two above the others, will often have been preserved" The value of the passage is that it explains how, in the face of universal death, a very small quantitative advantage may save the individual In normal times a giraffe with a neck two inches longer might gather 1 per cent more leaves than his brother and be perhaps ½ per cent better nourished, and the *advocatus diaboli* is in his rights when he claims that this would have no survival value In the great dearth, when all on the ground is eaten and the trees are stripped up to the full height that the tallest giraffes can reach, all must die of starvation Yet if half a dozen giraffes now come who can reach two inches higher, they will find two inches of untouched leaves on every tree, and they alone may survive, to transmit their slightly longer necks to their progeny after the cataclasm ‡

On these premises, there is little positive advantage to the progeny in having a *long* neck, the advantage in a dearth is in having a *longer* neck than the rest of the population At the next similar cataclasm the survivors would be those with necks two inches longer than the now increased usual maximum of neck, and the survivors of the second cataclasm would transmit necks two increments longer than those of the original population In a dearth, two inches added to the mean or modal length of neck might add, perhaps, a few hours to the duration of dearth required to kill off the herd, but the deviational excess of the length of neck in a single individual may ensure his solitary survival through another month of dearth If this deviational excess be heritable, we have it enforced on the post cataclasmal population as an example of what we may term 'futile' evolution, defining

* Slightly modified from a paper read before the Linnean Society, abstract in *Proc Linn Soc* for Feb 6, 1930

† The word 'cataclysm' has a valuable use in its original technical significance of a widespread submergence of land This was a legitimate application of the English form of the Greek word in Matthew xxiv 38, the Vulgate Latin 'diluvium' having been reserved for the supposed post-Tertiary universal deluge The modern protean use of 'cataclysm threatens to render the word unserviceable

‡ Such transmission will obviously take place to all descendants if the two inch longer neck be a Mendelian recessive mutation, and to 8/9 of the descendants if it be a Mendelian dominant, and the survivors show a typical sample of $2DD+4DR$ Most biologists would agree that there is no transmission if the extra height is merely 'metamplc —due to especially favourable accidents of nutrition and the like But on Galton's famous law of Heredity, which declared that to the total heritage of the offspring the parents on the average contribute 1/2, the grandparents 1/4 ', etc, if we agree with Bateson (1909 'Mendel's Principles of Heredity', p 6) that there was admittedly a statistical accord between Galton's theory and some facts of heredity ' and consider that the facts as to stature in giraffes probably come into this category —then, if all the pre-cataclasmal-ancestry be assumed normal, all the post-cataclasmal progeny would have a mean which deviates from the pre-cataclasmal mean by half the deviation of the survivors through the ordeal

'utile' evolution as that which enables the species to populate an environment where it could not otherwise have lived (Futility in evolution, not cataclasmal, is shown by the useless height of the 'canopy' in forests the trees of which have long been forest-trees, competing each against his neighbour [1] In human affairs, competition between nations has produced alike the evolution of manufacturing machinery, which is utile, and the evolution of battleships, which is futile)

Of the survivors who had been exposed to the Black Death in London many would have been selected for a physiological difference which enabled them to resist a single disease Since many centuries of normal environment had not selected this difference, those who possessed it were probably inferior men in normal environment The death in a war of a disproportionate number of the best of the nation is too widely and bitterly believed to be discussed

The Black Death killed up to half the population, but we are considering especially cataclasms after which not 1 in 1000 is left alive The problem presented itself in connexion with littoral sponges I have maintained the thesis [2] that the evolution of the canal system in sponges can be shown to result in the continuously improved separation of the expelled water, which is foul and deprived of food, from the supply of fresh water taken in the accepted sequence of evolution of the canal system demonstrably resulting in a more forcible jet from the vent, carrying the used water farther away from the sponge

On the rocks of Plymouth Harbour grow in profusion the sponges *Halichondria*, *Grantia*, and *Sycon* Sycon's well known bottle-brush scheme of canals is most easily shown to result in the jet (represented by the handle of the bottle-brush) having enormously more power than its tributary currents, which pour into it radially along the bristles *Halichondria* is the sponge in which Grant discovered sponge-currents he vividly described the extraordinary power of the ejection of water from the volcano like vents of the sponge With *Grantia* I have been able to demonstrate to friends a jet some inches long, several times its own length, even from a rather unhappy sponge

These three sponges live between tide-marks in the surf and the swirl, and the power of their jets is in that environment of absolutely no value to them It is known that they have lived on similar rocks in those parts for a hundred years with a generation every year, and it is reasonably certain that they have so lived for 10,000 years, and probably very much longer It seems certain, on the other hand, that their beautifully perfect canal-system—so admirable adapted to bring them food and oxygen in still water—*must* be essential to them

These apparent contradictions are reconciled if we consider that every now and again—maybe once, maybe a few times in a century—the whole of that littoral between tide-marks may have every sponge on it killed, and perhaps nearly every living thing The most obvious means of death would seem to be if heavy rain, of the rare intensity of an inch in an hour, were to fall on the rocks during the two hours of lowest spring-tide This would certainly not happen nearly once a century, but extreme heat from the sun at low spring-tide is another possible lethal agency, and in that part of the coast low springs are at the time of day when heat is greatest Confining ourselves still to natural causes, a landslip might conceivably poison the water, or mud might, for a tide, cover a long stretch of shore

After such a denudation the sponge population would be replaced by the larvæ from sponges in sheltered submarine caves Of the enormous number of larvæ from the surf-sponges, a few will fix on every surface within a long range The young sponge in a still, shut in, cave will not grow so large or so fast as her sister among the waves, but she can live and grow *because* of her perfect current system, and her larvæ can swim to the light, out of the cave, and repopulate the shore So that for the next century or so, until the next disaster, the rocks will grow thick again with *Sycon*, *Grantia*, and *Halichondria*, which will be all descended from a few ill nourished individuals that at the time of the cataclasm lived in retreats where a powerful canal-system was necessary to life Consequently we find the shore populated by littoral sponges with an elaborate anatomy which is useless for littoral existence

We see, therefore, that cataclasmal selection may enforce a character which (1) may be of no benefit in normal life, (2) may carry, associated with it, characters selected by environment before the cataclasm and transmitted because they were possessed by the only surviving organism, while (3) small quantitative differences may have survival value in a cataclasm We may tentatively consider whether some unsolved zoological problems may not be explained by cataclasmal selection Prof Poulton [3] has suggested the interesting case of the whelks of the Red Crag, which are all sinistral He has considered the probable explanation of this to be that there was a sudden refrigeration, which killed all but one whelk which happened to be sinistral, and that her progeny repopulated the Crag * Great cold, great heat, and floods are the most widely recognised depopulating agencies in our past history it may be permitted, interrogatively rather than assertively, to sketch some possible evolutionary results of the cataclasms such convulsions must have caused

The mass-wanderings of lemmings, and in a less degree of mice, rats, and squirrels, appear explicable if we assume a mutational madness, the possessors of which were the only survivors of their kind from the glaciation of northern Europe, and their descendants the only rodents to spread themselves over northern Europe when free of ice again The most inexplicable feature of the wanderings is the

* In 1882 all the Tile-fish off Nantucket were killed, 5000 to 7500 square miles of sea being covered with dead or dying fish, estimated to number 'one billion' (query, a thousand million ?), fifty being counted in a square rod This was attributed to the temporary lowering of temperature of the water —Lucas, 1889, Report of National Museum, Washington, p 612

lemmings throwing themselves into the sea Darwin's visualisation of the glacial epoch is helpful "The inhabitants of the more temperate regions would at the same time travel southward, unless they were stopped by barriers, in which case they would perish" [4] Therefore the sane lemmings which would not throw themselves into the fjords and rivers perished in the increasing cold Wiman * describes the state of a modern wandering horde as "a sort of madness", may we not conclude that this madness was a mutation which had occurred among the lemmings at the Glacial Epoch? Unafraid, the lunatics plunged into the obstructing lake, and because it was mostly frozen got safely across, and continued their lunatic wanderings over insane distances which brought them into gentler climates where they were able to live and produce young lemmings with lunacy inherited from both parents When the ice had passed these were selected again, because only the lunatics made the return journey, the others stayed south and died as the warmth increased On this hypothesis, therefore, in the pre glacial and again in the post glacial generation every ancestor of the modern northern lemming was possessed with a wandering madness

It is worth considering whether there may not have been crises in our own ancestry through which no man lived who was not possessed with the appropriate madness, and whether this form of cataclasmal selection may not explain some features in human psychology, particularly, perhaps, in the behaviour of a crowd On the other hand, the great drought in the central steppes of Eurasia, which drove our ancestors to migrate with their herds over thousands of miles of wolf-hunted plains, may account for the difference in ability for sustained concerted action between the descendants of the stationary Mediterranean races and those of the migrants †

The 'ordeal by fire' is one which must have left its mark in countries where forest-fires or prairie-fires are common, and where, therefore, during the ages, from time to time a succession of wind-changes will have extended the conflagration until the whole great forest was burned J Weigelt [5] says that one of the chief causes of mortality among larger animals escaping a fire is their being crushed to death by fellow-animals in the stampede Is it possible that the extraordinary lateral spread of the horns of some buffaloes and oxen has enabled their ancestors in such a crisis to survive those of the herd whose horns curved upward or forward?

* Quoted by Weigelt

† An observer of lemmings of considerable authority objected at the meeting of the Linnean Society, that lemmings make no considerable migrations or traverses of water, but only scatter from infected burrows under the influence of a known bacterial disease which renders them irresistibly thirsty Another, an authority on rodents, accepted this, and denied the mass-migration of rats or mice These two authorities are in conflict with the observers quoted by Johannes Weigelt ("Rezente Wirbeltierleichen, 1927, Leipzig, Max Weg, p 43) B Högbom observed a dense horde of swimming lemmings 2 to 3 kilometres long near Tromsö, Wiman travelled through such a swimming horde for an hour, and A Högbom observed a closely packed procession of some sort of field mouse (all quoted from *Paläont Zeitschr*, 1913, Berlin, Bd. 1, p 147) Waterton was convinced that "rats move from place to place in large bodies" ("Natural History Essays" [1880], London, Frederick Warne, p 241), but he only quotes one witness Lyddekker (*Enc Brit*, 1910–11, "Lemming") bases on Collett a circumstantial description of mass-migrations of the lemmings lasting one to three years, and writes that they are "impelled by the restless or migratory instinct possessed in "a less developed degree by so many of their congeners"

I am told that in Australia the first sign of a fire in the forest is the escape of the winged things—birds and insects This gives another reason for delicate olfactory organs in insects, equally cogent with sex or food

In Australia every tree and bush is burned, and nothing remains but hot ashes—through which the seedling eucalypti rise to refill the long swath in the forest But in Siam and India the old teak-trees stand, and in Honduras the mahogany trees, and Pinchot [6] says that in the United States, "Trees whose thick bark or abundant seeding gives them peculiar powers of resistance, frequently owe their exclusive possession of vast areas purely to the action of fire" In such resistant trees bees nests might be unburned even if all the bees were killed by the smoke Is it conceivable that the use of wax for the cells by social bees, instead of salival cement, has had the survival advantage of protecting the pupæ from the poisonous vapours of the forest fire which suffocate the adults of the hive?

Is it possible that the high development of the spleen, which can now save the life of a man after moderate poisoning by carbon monoxide, may have been forced upon mammals by forest and prairie fires? It must be remembered that for selective efficiency these disasters need not be frequent if they are terribly mortal

Dr G S Carter has recently explained [7] his interesting theory that fishes took to breathing air because of the lack of oxygen in tropical swamp-water I am not aware whether the descendants of any freshwater fish in the Carboniferous epoch were represented as freshwater fish in the Tertiary rocks *A priori* it would seem possible that with the enormous extent of stagnant tropical swamps at the time of the coal measures, all their aquatic inhabitants which were not air-breathing were suffocated, and so the sole descendants of carboniferous fresh waters may be the land animals

I will touch very lightly on the question that interests me very much—the probability, when we find an enormously numerous and powerful group, such as the insects or the birds, predominantly of one design, that their ancestors went through some deadly ordeal in a fairly advanced stage of their history, from which only one (or very few) species survived, so that the orders and families of the group are variations on a highly specialised ancestor the general scheme of whose structure is preserved Elsewhere I have suggested [8] that in the case of the insects the ordeal was the violent flooding of the land (cataclysm) in Torridonian times, from which one or possibly two or three species of insects were the only land animals to survive The Silurian fossil evidence is now considered by entomologists to be negative, but on the other hand they find it difficult to explain the insects of the Carboniferous and Upper Devonian without assuming a long history behind them [9]

For the birds—is it possible that their ordeal was a sudden development of rapid movement in flesh-eating mammals, which massacred every bird

(excluding ostriches, penguins, and so on) except the one species which had learned to perch on a fine twig? I am too ignorant to judge or discuss this question, and am conscious that we have touched above on many questions as to which I am culpably ignorant, and seek and expect correction. My object, in thus inviting personal humiliation, has been to ask each biologist whether, in the groups of which he has knowledge, the recognition of cataclasmal selection may not explain otherwise inexplicable characteristics, as it appears to me to do in the littoral sponges.

[1] Described in *Proc Linn Soc* for Mar 6, 1930 "In the Canopy of the Forest", by Major R W G Hingston
[2] *Quart Jour Micr Sci*, 67, p 293, 1923
[3] *Proc Linn Soc* for Feb 6, 1930
[4] "Origin of Species" (First Edition), p 366
[5] Loc cit p 40
[6] "Forests and Forestry", *Enc Brit*, 1910–11, p 658
[7] *Proc Linn Soc* for April 18, 1929, p 53
[8] *Brit Assoc. Rep* (Leeds), 1927, p 60
[9] Tillyard NATURE, June 12, 1926, *Trans Ent Soc Lond*, 76, p 70, 1928

Obituary

DR JAMES WATERSTON

THE death of James Waterston, which occurred on April 28, some weeks after a serious operation, is a severe blow to applied no less than to systematic entomology. For many years past Waterston's entomological interests, though largely concerned with the British Mallophaga (bird lice) and with the Siphonaptera (fleas), had centred chiefly in the, usually minute, Hymenoptera known comprehensively as Chalcidoidea, many of which are of extreme importance as being in the larval state parasitic in caterpillars destructive to crops, in the pests of stored grain, and in other harmful insects such as tsetse flies.

Born at Paisley on Feb 7, 1879, Waterston was educated at George Watson's College and the University of Edinburgh, where he graduated, with honours, in divinity, philosophy and science, and afterwards proceeded to his doctorate in the latter subject. After spending some years in the ministry of the Free Church of Scotland, during which he published many papers on ectoparasites, Waterston resigned his living in the Shetlands, and, in April 1914, joined the staff of the Imperial Bureau of Entomology; his interest in and work upon the Chalcidoidea date from this period. In May 1917, after receiving a temporary commission in the R A M C, Waterston was appointed entomologist to the Malaria Commission, Salonica, being afterwards mentioned in dispatches and demobilised after the Armistice with the rank of captain. On May 20, 1920, he left the service of the Imperial Bureau of Entomology and entered that of the Trustees of the British Museum, in which at the time of his death he occupied the position of assistant keeper (first class) in the Department of Entomology.

A good all round zoologist, capable botanist, and strenuous and enthusiastic worker at the groups of insects which more especially appealed to him, Waterston was also a prolific writer, and, commencing in the year 1903, published no fewer than one hundred and sixty-four entomological papers. While the majority of these more particularly concern the systematist, the list includes pamphlets on fleas and lice (in the British Museum "Economic" series), and a valuable paper on the bionomics of sand flies (*Phlebotomus*), issued in 1922 as one of the results of his field experience in Macedonia. Among the projects abruptly terminated by Waterston's untimely death is a monograph of the British Mallophaga, for which a portion of the text and many of the illustrations had already been prepared.

Waterston's wide knowledge was ever at the service of those who sought his aid, and few of those who did so and found him at work at his table in South Kensington can fail to have been struck with his marvellous gifts as a dissector of tiny insects. To see him disarticulate, and display on a microscope slide, the mouth-parts or genitalia of a Chalcid, which itself measured but a millimetre or two in length, was a lesson in technique not easily forgotten.

E E AUSTEN

MR HUGH S R ELLIOT

BY the lamentable aeroplane accident which occurred at Hampton in Middlesex on May 6, an able and popular writer on scientific and philosophical subjects has been removed from our midst at the early age of forty nine years. Mr Hugh Samuel Roger Elliot was born on April 3, 1881. His father was the Hon H F H Elliot, son of the third Earl of Minto, and he himself was a cousin of the present earl. He was educated at Eton and at Trinity College, Cambridge. But his career at Cambridge was cut short through the outbreak of the South African War in 1899, when he obtained a commission in the Coldstream Guards.

On leaving the army in 1902, Mr Elliot devoted himself largely to scientific and philosophical studies. His first considerable literary undertaking was to edit the two volumes of "The Letters of John Stuart Mill", which appeared in 1910. This piece of work he accomplished with conspicuous care and thoroughness, and his estimate of Mill's character and achievements in the introduction is remarkably just and discerning. Unfortunately, one can scarcely speak in like terms of the book he published two years later, entitled "Modern Science and the Illusions of Professor Bergson". While, no doubt, he did succeed in exhibiting some of the weaknesses of Bergson's philosophy, he had too little patience with Bergson's mode of thought to appreciate its real significance, and his criticism of it was for the most part superficial and ineffective. He was far more at home in the volume he wrote on "Herbert Spencer", which was one of a series edited by Basil Williams and published in 1917. In his younger days he had been a fervent admirer of Spencer, and although, after an interval of fifteen years, he had come to see that much of the 'synthetic

philosophy' was ill founded and false, the book is an interesting and sympathetic study of Spencer's work and personality A serious blemish in Spencer's evolution theory seemed to Mr Elliot to be the assumption of the transmission by heredity of acquired characters, an assumption which he took to be without justification He had already argued to the same effect in the introduction he wrote to his translation of Lamarck's "Philosophie Zoologique" This translation, which was done with great skill and accuracy, appeared in 1914

Mr Elliot had a rooted contempt for what he called 'metaphysics', which he stigmatised as "a maze of sesquipedalian verbiage, beyond the reach of science to defend or to refute" Probably he got his conception of 'metaphysics' from the treatment in "First Principles" of 'the Unknowable', which he regarded as altogether extraneous and unnecessary to Spencer's philosophy as a whole He himself defended a thorough going doctrine of materialism, according to which 'physical law' is universally dominant, and mind or consciousness is "only an inert accompaniment of material cerebral changes" In his later volume, "Modern Science and Materialism", which was published in 1919, he was, however, compelled to modify to some extent his earlier view

Mr Elliot was a forcible and trenchant writer, his books and essays were always readable, even when they failed to carry conviction He was happier in expounding scientific theories than in criticising philosophical ones, and his articles on social and political topics were characterised by keen insight and sagacity His materialistic doctrine is already a spent force, but his survey of Spencer's system and his account of Lamarck's contributions to biology are not likely soon to be forgotten G Dawes Hicks

Dr P A Wagner

The death of Percy Albert Wagner on Nov 11, 1929, at the early age of forty four years, removed from a larger sphere than that of South Africa one of the most prominent workers on the economic side of geology Conjointly, the South African School of Mines, Freiberg and Heidelberg, contributed to the determining of his career Much was accomplished in that relatively short life, principally among the platinum and diamond deposits of the Transvaal, and to a rather less extent in the geology and mineral resources of South-West Africa, for Dr Wagner seldom strayed in his investigations beyond the southern section of the continent His Memoirs on the "Fides-Stavoren Tinfields" (1921), on the "Iron Deposits of the Union of South Africa" (1928), and that exceptionally interesting work on "The Pretoria Salt pan, a Soda Caldera" (1922), are typical examples of the thorough—and also the clear and systematic—manner in which the subject on hand was treated

The salt-pan formed one of the 'Problems' dealt with in Wagner's presidential address to the Geological Society of South Africa in 1917 An earlier book on "The Diamond Fields of South Africa", written in 1915 (preceded in 1909 by a volume on the same subject published in Berlin), is still a standard work of reference "The Platinum Deposits and Mines of South Africa", in which the structure and petrography of the Bushveld Complex receive all but exhaustive treatment, is an outstanding example of the minute care with which he handled his subject, dealing with it, so far as was possible, from every point of view In describing these sulphide ores, he was in his element

Appointed Geologist for the Mineral Survey in 1918, Wagner left Government service in 1927 to undertake consulting work, chiefly concerned with platinum and diamonds, finding it necessary to crowd much writing into time which most men would have considered fully occupied with strictly professional matters In his last memoir for the Geological Survey, that on the "Iron Deposits", he laments that he had only two and a half months for the microscopic work and systematising and summarising the observations of the preceding ten years "The Platinum Deposits" was written hurriedly, but one looks in vain in either for those "obvious shortcomings" he saw himself in the earlier work The memoir on "The Geology and Mineral Industry of South West Africa" (1916) is a most useful compendium of original observations and the publications of other geologists, mostly German, but perhaps the broad outlines of stratigraphical geology were not altogether Wagner's *metier*, though one feels that had his bent led him in this direction, he would have accomplished much

As his field work was essentially South African, so Dr Wagner's publications are principally to be found in South African journals No paper of his appears under the ægis of the Geological Society of London or in the *Transactions* of the Institution of Mining and Metallurgy This is of small moment, his reputation was world wide, and even those of his profession who had never met him felt a keen sense of loss at his untimely death J P

We regret to announce the following deaths

Prof John N Cobb, dean of the College of Fisheries at the University of Washington, Seattle, a past president of the Pacific Fisheries Society, on Jan 13, aged sixty two years

Mr G C Dudgeon, C B E, formerly consulting agriculturist, Ministry of Agriculture, Egypt, well known for his interest in tropical agriculture and entomology, on May 4, aged sixty two years

Prof Stephen A Forbes, since 1917 chief of the Illinois State Natural History Survey, member of the U S National Academy of Sciences and past president of the American Entomological Society and of the Association of Economic Entomologists, on Mar 13, aged eighty five years

Dr Christine Ladd Franklin, lecturer in psychology and logic at Columbia University, and originator of the theory of colour vision known by her name, on Mar 5, aged eighty two years

Prof Max Matthes, director of the University Medical Clinic, Königsberg, one of the secretaries of the German Society for Natural Science and Medicine for the forthcoming meeting in Königsberg, on Mar 26, aged sixty five years

News and Views.

The organisation of the Wedgwood festival, held during the past week in Stoke on Trent, has been remarkably efficient Judging by the tremendous enthusiasm shown and the large attendances in the earlier items of the seven day programme, the Wedgwood bicentenary will leave a lasting impression on the minds of many thousands Commencing with suitable religious observances on Sunday, followed by a day of which the outstanding feature was the tremendous reception accorded to Princess Mary, succeeding days were allotted to transport, ceramics, industry, foreign trade, and Staffordshire Throughout the weekdays the remarkable historical pageant has been staged every afternoon in the most central park of the city The pageant was a great work of art embodying the musical, historical, and histrionic abilities of the district In a prologue and eight episodes, the history of the district was illustrated from the days when the early Britons stood in fear of the Roman legions in their midst up to the present day Perhaps the most interesting episode of all concerned the life of the great potter in whose honour the celebrations took place Incidents in the life of Josiah Wedgwood from the time when, as a youth, he worked at the bench as an apprentice, up to the latter days, when he had become a great industrial leader and an honoured man of science, were shown with a faithful representation of conditions and costumes which made the history live again

The modern claims of the pottery industry to world wide appreciation were splendidly upheld by an exhibition in Stoke on Trent of the products of some seventy firms, amongst whom are some of the most famous makers of china, earthenware, tiles, sanitary and electrical wares It is confidently asserted by independent witnesses that no exhibition of modern pottery of such variety and merit has been staged anywhere since the War The display of pottery of historical interest, exhibited in the Hanley Museum and including some of the choicest examples of jasper ware from H M the Queen's collection, was alone worthy of a special visit Included in this display we particularly noted one of the copies of the Portland Vase, an encaustic painted vase thrown by Wedgwood's own hand on the day in 1769 when the Etruria Works was formally opened, and a number of portraits in oils, of which one of Josiah Wedgwood by Reynolds is probably the most important The Ceramic Society, in issuing Part I of its commemorative volume, has produced a work of exceptionally varied interest Contributions from technical specialists the world over deal with a wide variety of important questions, whilst the prize essays on the contributions of Josiah Wedgwood to the technical side of the pottery industry embody new material of the greatest value

The opening on May 15 of the Electrical Research Laboratory at the Stourport works of Steatite and Porcelain Products, Limited, is a welcome sign that manufacturers now thoroughly recognise the importance of scientific research We agree with the remark made by Sir Philip Nash at the ceremony that in the future there will probably be a great network of international lines for power transmission This would bring power to our industrial centres at a price much cheaper than they can generate it for themselves The power must be transmitted at the highest possible voltage, and so the manufacture of porcelain insulators is necessary for our progress The new research laboratory at Stourport is equipped with apparatus for testing both the mechanical and electrical properties of the insulators There is a high voltage room, a mechanical laboratory, a fog room, and an open-air testing field The high voltage room covers 4300 sq ft and is 45 feet high It is equipped with a 500,000 volt testing alternator and two 450,000 volt testing transformers A pressure of a million volts can be obtained, and by connecting in cascade the pressure can be increased 20 per cent In addition, an impulse plant in which two high-voltage condensers are charged by a unidirectional current enables the effect of a direct lightning stroke to be imitated It is stated that in this way pressures of 1,800,000 volts have been obtained The unidirectional current for charging the condensers is obtained from a mechanical rectifier, which allows a voltage double that of the peak voltage of the transformer supplying the current for rectification to be obtained The tests are applied to the insulators under normal conditions and under artificial rain In addition, in the special room, investigations can be made under conditions of heavy fog, mist, salt spray, and artificial fouling by solid matter The mist is obtained by suspending the insulators in a refrigerator and then removing them to the higher temperature of the fog room

Prof Niels Bohr delivered the fourteenth Faraday lecture before the Chemical Society on May 8, the title of his discourse being "Chemistry and the Quantum Theory" Prof Bohr said that we owe to Faraday a large part of the common basis on which chemistry and physics are to day being built, in order to appreciate the situation in which we now find ourselves, we have to take account of the attitude of mind characteristic of physical and chemical research Two fundamental discoveries were those of the quantum of electricity and the quantum of action, characteristic of two different aspects of the atomic theory The discovery of the structure of the atom gives us a picture of the units of electricity, but the behaviour of these particles cannot be described by the ordinary ideas of mechanics and electricity The discovery of the quantum of action resulted from a study of statistical problems, as soon as we attempt to get an idea of what this quantum of action is, apart from the statistical view, we find it an impossible task Having referred to quanta of light, and to the modern view of the significance of line spectra, Prof Bohr said that the problem of utilising the discovery of the structural unit of the atom in explaining its properties is

difficult, for any reference to the mass of a particle requires reference to Newton's classical mechanics Interpretation of the properties of elements becomes possible if variations in the direction in space of the magnetic moment of the electron are postulated Progress has depended on the application of the cor respondence principle correlating quantum mechanics with classical mechanics, and has been facilitated by the introduction of the concept of wave mechanics

CONTINUING, Prof Bohr said that wave mechanics, conceived by De Broglie, has provided us with corre lation between the motion of a particle and wave propagation The electron is not the wave, nor can we discover its paths of motion, but we are able to determine whether an electron is or is not there Whenever we experiment on an atom, therefore, we always find it in one of its stationary states, this view of the existence of atoms in 'stationary states' has been confirmed by every experiment yet designed to test it The existence of a quantum of action leads to the position that we cannot obtain any knowledge concerning natural phenomena without influencing them by our observation According to our ordinary ideas, the electron has position and momentum, but when we attempt to prove that it is at a certain point, we find that we cannot do so without affecting its momentum Hence we can never get simultaneous knowledge of position and momentum Prof Bohr declared that this disability represents something quite fundamental, it implies that space and momen tum are in some degree mutually exclusive Similar limitations are concerned with time and energy, we cannot at the same time use the concepts of time and of conservation of energy In considering the station ary states of the atom, we are not concerned with time, and hence the idea has a large field of applica bility Referring to the work of Dirac, Prof Bohr remarked that it is never possible to measure the electric moment of a single electron The word 'electron' is losing its simple meaning A large part of the progress of physical science has been concerned with motion and mechanics, chemists, who have been largely concerned with properties, must follow so far as possible the concepts of motion At the conclusion of the lecture the president, Prof J F Thorpe, presented to Prof Bohr the Faraday Medal, the highest honour in the bestowal of the Chemical Society

MR H A STUYT's paper on "The Bavenda", de livered at the Royal Anthropological Institute on May 13, and Major Trevor's paper in the preceding week on certain survivals of pre European culture among the natives of Rhodesia, were both of noteworthy im portance in their bearing upon one side of the Zim-babwe controversy It has always been something of a stumbling-block, to some at least, in the way of the complete acceptance of the theory of the native origin of the Zimbabwe ruins, that while the culture as a whole is distinctly African—a point brought out very emphatically by the present exhibition at the British Museum—it does embody elements which appear, so far as known, something of a departure in Bantu cul ture, and at best scarcely cognate to the culture of the natives of to day On this point the observations of both Major Trevor and Mr Stuyt appear to throw some light For in culture and social and religious organisation the Bavenda show marked differences from the other native tribes of Rhodesia Major Trevor for example, noted the existence among the Bavenda of clay phallic altars in use in initiation cere monies, while Mr Stuyt directed attention to carved wooden dishes or bowls used for purposes of divina-tion ceremonies, which present a close resemblance to the shallow clay trays now exhibited from Zimbabwe It is noteworthy that the Bavenda make use of dry-stone wallings very similar in appearance to those at Zimbabwe One kraal also exhibited the remarkable and rare occurrence of a monolith erected upon it, again re calling a feature of Zimbabwe These, with many other similarities, are sufficient to point to the possibility of the Bavenda having occupied the Zimbabwe country Although copper working is not yet definitely associ ated with Zimbabwe, it is possible, for until forty or fifty years ago the Bavenda were copper workers

IN his Friday evening discourse delivered at the Royal Institution on May 16, Dr C M Yonge de-scribed the Great Barrier Reef of Australia and dis cussed some of the results obtained by the expedition under his leadership which has recently investigated its structure and biological associations The reefs are built up on a shallow platform which fringes the north east coast of Australia and is very wide in the south but narrows in the centre, to broaden out again in the region of the Torres Strait The reefs are most abun-dant near the outer side of this platform and so en-close a sheltered channel which forms the main steamer track from the eastern ports of Australia to the Far East This channel is dotted everywhere with islands, of which many are high, rocky, and of great beauty and were probably originally part of the land mass of Australia, while in the northern half of the Barrier there are great numbers of small coral islands These low woody islands, on one of which the Great Barrier Reef Expedition lived for twelve and a half months, are all situated on small reefs moulded into a crescent shape by the south easterly trade wind They each possess on the lee side a small sand 'cay' covered with trees and bushes, and on the exposed south eastern side, in the shelter of great banks of shingle, mangrove swamps The reefs of the Barrier can be divided into two series, outer and inner The former face the full force of the Pacific and are swept bare on the upper surface, while the inner reefs are a little higher and so exposed more by the tides and have occasionally small sand cays upon them There is a great abundance of coral on their outer slopes, which descend quickly into deep water, while on the sheltered lee of the reefs great pinnacles of living coral render navigation difficult This great series of reefs possesses many animals of economic value, while its powers as a natural breakwater have earned for the enclosed channel the title of Australia's Grand Canal, but it is a canal full of dangers, as frequent shipwrecks testify

IN a recent address to the Students' Section of the Institution of Electrical Engineers, Sir Thomas Purves, the engineer to the Post Office, gave an interesting account of ship shore telephony, the latest development of electrical communication engineering The service at present covers the Atlantic Ocean The main receiving station is at Baldock, about 30 miles north of London The site of the station is in the centre of a large flat plain, carefully chosen so that no roads are nearer than a quarter of a mile to the aerials This is to prevent interference from the short waves which are radiated from the ignition systems of motor cars The working wave length of the receiver can be varied continuously over the range between ten and a hundred metres The transmitting station is at Rugby and can be worked at several frequencies For short wave telephony it is necessary to maintain the transmitted frequency within limits of the order of one part in ten thousand Piezo electric quartz oscillators, therefore, are provided They are enclosed in an oven the temperature of which is automatically regulated within very narrow limits The transmitter supplies a high frequency carrier wave to the aerial with an output power of about five kilowatts The procedure of making a call is as simple as that of any long distance trunk call The charge for the service is £4 10s for three minutes plus £1 10s for each additional minute The connexion of Rugby to the London trunk exchange is by 85 miles of underground cable, and Baldock is connected by more than 30 miles of cable to the same exchange On a recent outward voyage of the S S *Majestic*, the useful period of 10 A M to 6 P M ship's time was adequately covered The output of the ship's transmitter was about two kilowatts The principal wave lengths used are 16, 24, and 36 metres, but in order to improve the communication at very short ranges, experiments on longer wave lengths are being made

MR H C LAMB, engineer to the Manchester Corporation Electricity Department, gives an interesting account of the development of the Manchester system of supply in *World Power* for March and April The public supply began in 1893 to an area of about one square mile It has now grown to fifty two square miles The initial supply was at 200 volts on the three wire system, as early electric lamps were only made for pressures of 100 volts In 1902 high pressure supply was started at 6600 volts, three phase, with conversion to direct current supply at substations In 1923 the Barton Power Station with its connected system of 33,000 volt underground mains was brought into use These transmission lines go to seven points where the current is transformed down to 6600 volts and then supplied to the distributing substations The coming of the 'grid' has affected the development of the Manchester system The grid in the north west of England and in North Wales can be divided roughly into three main rings and the Barton Station forms a pivotal point for them Just as the 6600 volt network became a secondary when the 33,000 volt supply was introduced, so now the 33,000 volt supply has become a secondary system owing to the introduction of the 132,000 volt grid It is difficult to say whether this is the final stage in the development or not It would be unsafe to prophesy The enormous power now being distributed and the absolute necessity of continuity of supply has led to the introduction of a very elaborate and complicated system of safety devices and fault clearing apparatus Mr Lamb recalls that, in the early days, all the mains were connected up directly with the generators without fuses or circuit breakers When faults occurred —and there were many—the engines groaned, the brushes on the commutators sparked violently, and the staff held their breaths as the fault burned itself clear

MANY suggestions are being made for supplying electricity on an economical basis to remote rural districts Several engineers are strongly in favour of increasing the permissible variation of the supply at the terminals of the consumer At present, if the supply company varies the pressure of supply by less than four per cent up or down, no legal action can be taken To give it permission to increase this variation to five or six per cent would in many cases diminish considerably the costs of distribution to the company without affecting in any way the great bulk of its consumers Only a few consumers on the outskirts of the network, and those near the station, would be affected, and probably the small alteration in the pressure would pass unnoticed The legal enactment necessary to provide for this change would doubtless insist that the saving effected would be reflected in the charge to the consumer On the other hand, the lamps of the consumers living near the source of supply would have a shorter life, although their efficiency would be increased The lamps of those living far from the station would have a long life and low efficiency When it is remembered that a variation of one per cent in the pressure means a variation of three or more per cent in the light given out, it will be seen that a variation of six per cent would scarcely be fair to those whose pressures are effected, although they might not notice it, as sudden changes rarely occur It would be very costly to treat every consumer equitably We see no objection to allowing a latitude of six per cent in special cases where the present rule makes a proposed scheme uneconomical and would be consumers know what to expect

A THOUGHTFUL paper by L Berkeley and Major Raven Hart on the effect of broadcasting on the development of music is printed in the *Nineteenth Century* for May They point out that the musician and the music lover of the future will be practically restricted to radio for their education, since for each one concert attended personally they will be provided with at least twenty by radio For those living in the country, the proportion will be much higher It may be objected that at the present time one concert attended is worth more than twenty heard by radio, but this is a passing phase Radio technique is making substantial advances every year, and soon radio

listeners will be nearly on the level of the concert goer. One effect of this will be that music which does not broadcast well will be more and more neglected. Bach broadcasts better than almost any other composer, and Wagner's music is very badly reproduced. Jazz, unfortunately, with its very often puerile harmony, comes through excellently. Luckily, however, there are great possibilities in connexion with broadcasting music. For example, when the composer desires a harp to give a solo, he does not need to reduce the rest of the orchestra practically to silence; all that is necessary is to move the harp nearer to the microphone. A tuning fork can make itself heard against an orchestra in a concert hall. The pianissimo quality of a solo instrument can in this way be made to dominate any orchestration. A narrator can speak through a concert performance and almost overpowering emotional effects can be produced. This was excellently illustrated on Mar. 18 of this year when Hindemith Weill's "Lindbergh's Flight" was transmitted from Berlin to London. The authors emphasise the need for immediate experimental work by musicians and broadcast engineers in close co-operation. This is already being done at the Berlin 'Wireless Academy', and the example should be followed in England. A month rarely passes in Germany without some important musical work being specially written for broadcast reproduction.

HISTORIC wireless apparatus, including early receivers and other apparatus used by Marchese Marconi and his collaborators, and an original Fleming two electrode valve, forms part of a window display at Marconi House, Strand. The Marconi aircraft transmitter, receiver, and direction finder which secured the rescue of Captain Courtney and his companions when their flying boat caught fire and was forced to descend in mid Atlantic comprise another exhibit, illustrated by a series of photographs depicting the machine on the sea and the rescue. Other photographs show comparisons between modern and early wireless stations, including a photograph of the original 2LO, and a map is shown of present day world wide cable and wireless services. In contrast with the first valve are three modern transmitting valves, one of them of the water cooled type, for broadcasting and high power wireless telegraph stations.

SCIENCE Service announces that at the recent meeting at Washington of the National Academy of Sciences the following medals were presented: Public Welfare Medal to the late Stephen T. Mather, organiser of the U.S. National Park Service and its director through the first years of its work; Daniel Giraud Elliot medal and honorarium, which is given for the most meritorious work in zoology or palæontology published each year, to Ernest Thompson Seton, whose book, "Lives of Game Animals", was selected as worthy of the prize for 1928; Agassiz Medal for oceanography to Dr. Johannes Schmidt, director of the physiological department of the Carlsberg Laboratory at Copenhagen, known for his work on the life history of the eel; Mary Clark Thompson Medal, for the most important services to geology and palæontology, to Prof. William Berryman Scott for distinguished work in palæontological research.

THE following have been elected members of the U.S. National Academy of Sciences: Prof. C. A. Adams (electrical engineering) Harvard University; Dr. J. W. Alexander (mathematics) Princeton University; Dr. Eugene T. Allen (geophysics) Carnegie Institution of Washington; Prof. Harry Bateman (mathematics) California Institute of Technology; Dr. Isaiah Bowman (geography) American Geographical Society, New York; Dr. G. P. Clinton (botany) Agricultural Experiment Station, New Haven, Conn.; Dr. William W. Coblentz (physics) U.S. Bureau of Standards; Dr. P. S. Epstein (mathematical physics) California Institute of Technology; Dr. Vernon L. Kellogg (biology) secretary of the National Research Council; Dr. F. G. Keyes (chemistry) Massachusetts Institute of Technology; Dr. K. S. Lashley (psychology) Institute of Juvenile Research, Chicago; Dr. Berthold Laufer (anthropology) Field Museum of Natural History; Dr. S. C. Lind (chemistry) University of Minnesota; Dr. Frank E. Ross (astronomy) Yerkes Observatory; and Dr. A. H. Sturtevant (biology) California Institute of Technology. Prof. R. A. Millikan, of the California Institute of Technology, has been re-elected foreign secretary of the Academy for a term of four years.

THE Second World Power Conference will be held in Berlin on June 16-25. This will be the second plenary meeting of the World Power Conference; sectional meetings have been held at Basle (1926), which dealt with the utilisation of water power and inland water ways, the London Fuel Conference of 1928, at Barcelona (1929) on water power utilisation, and at Tokyo (1929) on the development of power resources, the latter coinciding with the World Engineering Congress. The honorary patron of the 1930 Conference at Berlin is President von Hindenberg, the honorary president being Dr. Oskar von Miller, the founder of the Deutsches Museum at Munich and pioneer of the electrical supply industry, while Dr. C. Köttgen will be chairman of the Conference. The management of the Conference is in the hands of the organisation set up by the German National Committee for this purpose at the Ingenieurhaus, Berlin N.W.7. Of the 400 papers submitted, copies of which will be printed and sent out on request before the meeting, only the most important statements will be dealt with by the general reporter at the meeting itself. The discussions that then take place constitute the most valuable part of the Conference. In addition to the purely technical programme, a series of addresses on present and future power supply problems will be delivered, and on the conclusion of the Conference special facilities are being granted for visiting the most important power and industrial plants in Germany. The public lectures include one by Prof. A. S. Eddington, on "Subatomic Energy", and one by Prof. A. Einstein, on "The Physical Space and Ether Problem."

THE speech delivered by Sir Robert Hadfield, as chairman of Hadfields, Ltd., on the occasion of the

annual meeting of the company on Mar 17 last, which has recently been issued, is in refreshing contrast to the usual type of address favoured by chairmen of industrial companies It is to be wished that the directors of great industrial concerns were more frequently men of scientific attainments and experience, with an intimate knowledge of the processes and products of their undertakings As might be expected of its author, the address ranges over a wide field, from the proposed scheme of an Empire Development Board, the importance of which the chairman has striven to bring home to the public as a practical alternative to the political and fiscal remedies now so widely advertised, to the recent developments in the metallurgy of steel Sir Robert Hadfield shows some scepticism regarding modern tendencies in pure physics, but he fully recognises the value of scientific research, and records remarkable results obtained by the systematic investigation of the properties of metals After discussing the changes which have been brought about in the practice of engineering by the introduction of manganese and silicon steels, he goes on to describe the uses of the heat resisting steels which are now a special product of the firm The fact that steels are now obtainable which have an extraordinarily high resistance to oxidation even when exposed for long periods to temperatures so high as 1200° C is of the highest importance to the chemical as well as to the engineering industry

A CONVERSAZIONE of the Institution of Electrical Engineers will be held, by permission of the Trustees, at the Natural History Museum, South Kensington, on Thursday, June 12, at 8 30 11 P M

THE annual visitation of the Royal Observatory, Greenwich, will be held on Saturday, June 7, when the Observatory will be open for inspection by guests of the Board of Visitors at 3 30 P M

DR W H ECCLES will deliver his presidential address to the Institute of Physics on Tuesday, May 27, at 5 30 P M, in the rooms of the Institution of Electrical Engineers, taking as his subject "The Influence of Physical Research on the Development of Wireless" The address is open to the public without ticket

ON Wednesday, June 4, in the Physics Theatre of King's College, London, Prof T H Laby, who is home on short leave from Melbourne, will read a paper before the Faraday Society on "Qualitative and Quantitative Atomic Analysis by X rays" The subject matter of the paper is indicated in the letter by Prof Laby and Mr C E Eddy which appeared in NATURE of April 5, p 524 Invitations to attend the meeting are being sent to physicists and metallurgists, and considerable interest is likely to be aroused by the technique used by Prof Laby At the same meeting a short paper by Mr Calvert, who is working with Prof G Hevesy at Freiburg im Breisgau, will also be read

THE Council of the Institution of Electrical Engineers has made the following awards of premiums for papers read during the session 1929–30, or accepted for publication *Institution Premium* to Mr H H Harrison, *Ayrton Premium* to Messrs B A G Churcher and A J King, *John Hopkinson Premium* to Mr L C Grant, *Kelvin Premium* to Mr T G N Haldane, *Paris Premium* to Messrs H A Humphrey, D M Buist, and J W Bansall, *Extra Premiums* to Messrs S W Melsom, A N Arman, and W Bibby, Messrs E H Smythe and E G Weeks, Messrs T W Ross and H G Bell, Mr W West, Mr Bernard Leggett, Mr J C Prescott, and Mr H W Taylor *Wireless Section Premiums* *Duddell Premium* to Mr J E P Vigoureux *Extra Premiums* to Capt P P Eckersley and Mr N Ashbridge, Mr G Shearing, and Capt J W S Dorling

THE first award of research fellowships in tuberculosis provided from a fund established by a recent benefaction in memory of Dorothy Temple Cross will be made by the Medical Research Council in July, for the academic year beginning on Oct 1 Applications should be lodged with the Council not later than June 30 The object of the fellowships, as defined in the trust deed, is to give special opportunities for study and research to persons "intending to devote themselves to the advancement by teaching or research of curative or preventive treatment of tuberculosis in all or any of its forms" Candidates must be British subjects, and must possess suitable medical, veterinary, or scientific qualifications The fellowships will preferably be awarded to candidates who wish to conduct their studies or inquiries outside Great Britain Each fellowship will be of the value of not less than £300 per annum, with travelling expenses in addition, and will be awarded for one year It is also hoped to award one senior fellowship of considerably greater value to a well qualified candidate wishing to undertake intensive investigation into some special problem of tuberculosis Particulars are obtainable from the Secretary, Medical Research Council, 38 Old Queen Street, Westminster, S W 1

THE Report of the Director General of Public Health, New South Wales, for the year 1928, which has recently been issued, records the vital statistics for 1928 and gives full information on the public health administration of the State The birth-rate was 22 59, and the death rate 9 55, per 1000 of population, being 4 5 per cent and 1 0 per cent respectively below the averages of the previous five years Deaths from pulmonary tuberculosis continue to diminish, while the deaths from cancer and heart disease are increasing year by year We miss the research articles which have been included in former reports, only one investigation (on atmospheric conditions in textile mills) being reported

MESSRS W Heffer and Sons, Ltd, Petty Cury, Cambridge, have just issued Catalogue No 348 of second hand works, over 2000 in number, dealing with zoology and biology, anthropology and ethnology, agriculture, botany and gardening, chemistry and chemical technology, geology and palæontology, mathematics and physics, physiology, anatomy and medicine, etc The catalogue should be of service to librarians and others anxious to fill up gaps in their libraries

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —Probationary assistant constructors in the Royal Corps of Naval Constructors—The Secretary of the Admiralty (C E Branch), Whitehall, S W 1 (May 26) A full time engineering workshop instructor at the School of Engineering and Navigation, Poplar—The Education Officer (T 1), County Hall, S E 1 (May 26) A lecturer in biology, specially interested in sea shore life, at the Brighton Municipal Training College for Women—The Secretary, 54 Old Steine, Brighton (May 30) An advisory and research entomologist at the South Eastern Agricultural College—The Secretary, South Eastern Agricultural College, Wye, Kent (May 31) Full time lecturers in mathematics and biology at the Chelsea Polytechnic—The Principal, Chelsea Polytechnic, Manresa Road, S W 3 (May 31) A town planning assistant on the County Surveyor's staff of the Lancashire County Council—The Clerk of the County Council, County Offices, Preston (May 31) Inspectors of mine beacons in the Mines Department of Southern Rhodesia, and assistant road engineers in the Roads Department of Southern Rhodesia—The High Commissioner for Southern Rhodesia, Crown House, Aldwych, W C 2 (May 31) A full time teacher of electrical engineering at the Oldham Municipal Technical College—The Secretary for Education, Education Offices, Oldham (May 31) Two assistants at the Ditton Research Laboratory, East Malling, Kent, for making temperature observations and for running refrigerating machinery The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S W 1 (May 31) A research assistant and demonstrator in geology in the University of Leeds—The Registrar, The University, Leeds (June 2) An assistant editor of the *Pharmaceutical Journal*—The Secretary, Pharmaceutical Society of Great Britain, 16 Bloomsbury Square, W C 1 (June 2) A temporary full time physics and chemistry lecturer at the National Society's Training College for Teachers of Domestic Subjects—The Principal, National Society's Training College, Berridge House, Fortune Green Road, N W 6 (June 2) Chemists on the scientific staffs of research establishments of the Department of Scientific and Industrial Research—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S W 1 (June 6) A lecturer and head of the zoology department of the University College of the South West of England, and an assistant lecturer in the same department—The Registrar, University College, Exeter A head teacher of building construction at the Woolwich Polytechnic—The Principal, Woolwich Polytechnic, S E 18

ERRATUM—In the letter in NATURE of May 17 p 744, by Prof G Hevesy and A Guenther entitled 'Search for an Inactive Isotope of the Element 84 (Polonium)", seven lines from end should read 1 gm of each mineral examined cannot contain more than 10^{-11} gm of the element in question "

Our Astronomical Column

The Companion of Mira Ceti—Prof Aitken gives the following measures of this star in *Publ Ast Soc Pacific* for February

	P A	Dist
1923 82	130 3°	0 90″
1924 69	131 6	0 84
1925 56	128 9	0 78
1929 98	134 9	0 85
1929 99	134 5	0 87

He notes that the companion was sometimes not seen when the conditions were good, and infers that it, like the primary, is variable Its magnitude last December is given as 10

Zi-Ka-Wei Observatory—This observatory is four miles from Shanghai It was founded in the sixteenth century by the Jesuit Fathers Ricci, Schall, and Verbiest, after being long closed, it was reopened in 1873 A short illustrated history of the observatory has just been issued Warnings of typhoons were formerly given by semaphore, but for the last fifteen years they have been given by wireless The Fathers have received many testimonials of the value of these warnings, some specimens of which are reproduced Time signals are now also issued by wireless The observatory took part in the recent international determination of longitudes by wireless signals There is a photographic equatorial with aperture 15½ in, this has been used *inter alia* for the formation of an atlas of the moon in 15 plates with Chinese text The programme also includes sunspots, magnetism, and seismology, a star catalogue of 14,000 stars, and calculation of the perturbations by Jupiter of about 100 minor planets (the last by P E de la Villemarqué) The illustrations include an amusing Chinese caricature of the astronomers "looking for the second" when an earthquake stopped the clocks on May 14, 1926

Photograph of a Lunar Landscape—Many text books of descriptive astronomy contain pictures of 'ideal' lunar landscapes, which in most cases are more or less imaginary but in *L'Astronomie* for April, M M Darney reproduces a portion of a photograph taken on Feb 12 with the 22 cm equatorial at the Paris Observatory, it contains the region near the limb in the neighbourhood of Newton and Grimaldi, and is so oriented that the landscape appears much as it would be seen from a distant lunar aeroplane The slopes of the hills are seen in their true proportions, the steepest slopes in the region appear to be about 45°, but most of them are much more gentle One mountain is a simple cone without any accompanying ring, but the ring formation greatly predominates, and most of the rings appear absolutely regular and unbroken M Darney notes that it would be useful to take photographs of this kind of the regions that are generally invisible, but are occasionally brought into view at extreme libration Mr H G Tomkins is making a photographic study of the moon at his observatory at Dedham, and has photographed some of these little known regions One picture, exhibited at a meeting of the British Astronomical Association, showed a mountain with a curious appendage, resembling on an enormous scale some of the great stone blocks that have been lodged on terrestrial mountains by glacial action

Research Items

Cave Art in Palestine—In *Man* for May, Miss D A E Garrod figures and describes three objects of meso lithic age from the cave of Mugharet el Wad, which lies at the foot of Mount Carmel The cave consists of a large well lit chamber and long inner corridor facing north west and commanding a wide view of the plain In November 1928 it was found by means of trial trenches that the cave contains a very abun dant microlithic industry, without associated pottery, closely resembling the mesolithic industry found at Shubka in western Judæa in the spring of 1928 In association with this industry Mr Lambert, the excavator, found a carved bone and pierced shoulder blade The carving represents a young cervine animal fashioned partly in the round and partly in relief at the end of a fragment of some fairly large long bone The head is thrown back, possibly in the act of sucking, and the detail of the head is beautifully rendered The large eyes with well marked tear glands are very typical of the young deer Both ears are present The legs are carved in low relief on the shaft of the bone and show two series of horizontal incisions at the joint There are also a series of parallel notches on the breast, possibly intended to represent loose skin The shoulder blade which was found has a large elliptical hole cut through the thick part of the bone, close to the articular end It recalls the *baton de commandement* of western Europe The British School of Archæology took over the excavations from May to July 1929 It was found that the archæological sequence is Early Bronze, Mesolithic, Upper Palæo lithic, Capsian, Middle Aurignacian, Early Middle Aurignacian, Mousterian—the most complete pre historic sequence yet discovered in Palestine At the base of the Mesolithic was discovered a crude repre sentation of a human head shaped from a fragment of compact banded impure calcite—the first work of art of the Stone Age to be discovered in Palestine

Nature of Purposive Movement in Fishes—Under this title Mr Herbert O Bull, biologist at the Dove Marine Laboratory, Cullercoats (Report for the year ending June 30, 1929), whose most recent work on the subject has just appeared in the *Journal of the Marine Biological Association* (vol 16, No 2, March 1930), discusses the importance of such experimental work in providing information upon the factors which direct fishes in their purposive movements and so tend to explain their spawning and feeding migrations He shows from his own work how the common shanny, *Blennius pholis*, in a very short time is able to react purposively after suitable training towards a gustatory stimulus containing so little as 0 00075 per cent of its food substance dissolved in sea water With regard to those researches the author states "I now believe that it is in this diection, or in the one closely allied to it, that we shall find an answer to many of our big problems in animal behaviour, *but only if the utmost care is taken with the smallest practical details*"

Herring Researches at Cullercoats—In the Report for the year ending June 30, 1929, of the Dove Marine Laboratory, Cullercoats, Northumberland, edited by Prof A Meek, Director of the Laboratory, most of the space is taken up by the herring investigations Mr B Storrow continues his work on the same lines as in former years The East Anglian fishery in 1928 was so successful that the merchants had completed their cure before the season was finished This was due to the rich year classes of 1925 and 1922 The younger fishes arrived first and many of them were spawning The 1922 class, chiefly full fish, which arrived later, was also very abundant Its possible wealth was predicted in this report seven years ago The advent of large numbers of fish in 1927 which had joined the commercial shoals in their third year followed an abnormal flow of Gulf Stream water into the North Sea in 1926, similar to one in 1920–21 which was followed by certain alterations in behaviour of the herring shoals There is apparently a tendency since 1920–21 for North Sea herring to migrate towards the ocean at the approach of maturity, taking the fish away from the ordinary fishing grounds The greatest growth occurs with oceanic conditions In Part 2 of the herring work Mrs Cowan continues her studies on the measurements of the fish

Neuro-muscular Mechanism of the Gill of *Pecten*—Under this title (*Quart Jour Micro Sci*, vol 73, February 1930) Setna gives an account of an experimental and histological investigation of the gill of this mollusc The bases of the gill filaments are provided with two sets of non striated muscle fibres which are responsible for the movements of the lamellæ The connexions between ordinary and principal filaments contain muscle cells by means of which the movements of the filaments are brought about Each gill has four main longitudinal nerve trunks which are derived from the brain and the visceral ganglion A subsidiary branchial nerve not previously recorded in molluscs is described A branching network of nerve cells and fibres compara able with those of the mantle is scattered over the cenidial axis and the principal fibres The neuro muscular mechanism of the gill is more or less inde pendent of the rest of the body, for the principal responses may be obtained in the isolated gills The different movements of the gills in response to various stimuli are described and their significance to the feeding habits discussed

Pepper Cultivation—A general account of the history and cultivation of the pepper plant has been published by M G Kidavu and P A Venkateswaran (*Bull* 98, Agri Dept, Madras) Pepper, one of the earliest known spices in the world, is indigenous in India and was first cultivated on the Malabar coast It was one of the most important articles of trade with Europe during the Middle Ages, although it was recorded there much earlier Being a strictly tropical plant, with the jungle as its natural home, pepper requires a heavy rainfall, and when brought under cultivation thrives best on a well drained, virgin red laterite soil containing plenty of humus It is a perennial climbing plant propagated by cuttings The standards upon which the vines are trained may either be dead or living, but if the latter, it is important that care should be taken to select suitable plants, those, for example, with a deep rooting habit being essential so as to avoid competition for the surface soil water and nutrients Regulation of shading, and attention to terracing or other forms of cultivation to minimise soil denudation during the rainy season, are other important factors in pepper growing The necessity for manuring is only beginning to be con sidered, but it is already clear that the addition of humus of some kind is very beneficial In order to avoid disease, attention to drainage and the healthiness of young cuttings, and regular spraying with Bordeaux mixture are recommended The berries, after being thrashed from the spikes by treading, are dried on

mats or in prepared yards, both black and white pepper being obtained from the same plant but prepared differently As regards the economic aspect, pepper is a paying proposition, since after the initial outlay the annual expenditure is small Uniform bearing begins about the fifth or sixth year and the maximum yields are obtained from ten to twenty five year old vines, although with careful cultivation still older plants can be profitably grown

Petrology of the Izu Islands, Japan —In the *Bull Earthquake Research Inst*, Tokyo, Sept 1929, H Tsuya gives a detailed account of the island volcano Kozu shima and its rocks and discusses the geological and petrological relations of the Seven Izu Islands and the Izu Peninsula It is shown that the liparitic rocks of the Nii jima group (1) are not older than the more basic O shima group (2), both types of lavas having been extruded more or less alternately Whatever the genetic relations may be, there is now no intermediate rock type linking the two together They appear, therefore, to be of independent lineage Within each group the sequence of extrusion is as follows *Izu Peninsula* (*a*) Potash liparite → dacite → plagioliparite, (*b*) Propylite → andesite → basaltic andesite *Izu Islands* (*a*) Potash liparite → plagioliparite, (*b*) Basaltic andesite It is noteworthy that while the liparitic rocks have become progressively richer in silica, the ratio of K_2O to Na_2O has decreased The other series has become steadily more basic In these the ratio of FeO to MgO in pyroxene increases with the albite proportion in plagioclase

Core Drilling Bituminous Sands —An interesting point in connexion with methods of separation of bitumen from impregnated sands arises from recent work carried out in Alberta for the location of those deposits beneath overburden In the course of drilling through unoxidised bituminous sand, the action of cold water promoted a ready separation of the bitumen from its host, and as much as 96 per cent bitumen was recovered from one sample by scraping it from the cable tool bit Where the bituminous sand has been exposed to the action of the weather for any time, separation is not so readily effected, but it is a fact that most separation processes have been based on material taken from outcrop, that is subject to atmospheric action It would be a point of both scientific and economic importance to know what resistance to separation is manifest by bitumen which has been made to impregnate sand the constituent grains of which are coated to a greater or lesser extent by limonitic films whether, given the same degree of bituminous saturation, a non ferruginous sand (for example, glass sand) or a strongly ferruginous sand would give up its hydrocarbon content to water flush more readily Alternatively, it may not be a question of the sand grain coating at all possibly the facility of separation is a function of the freshness of the bitumen itself, for clearly where this material is exposed to the atmosphere, it undergoes changes which cannot be set up so long as it is hermetically sealed from the influence of meteoric water One cannot help feeling that both possibilities must be taken into account The report by S C Ells (Canada, Dept of Mines, 1929) dealing with the exploitation of these sands gives point to this matter from the observations made while actually drilling but the author does not discuss the significance of it in the sense outlined above

Rainfall of the World —A new rainfall map of the world is given with a paper by Dr E Ekhart in *Petermann's Mitteilungen* (Hefte 3/4, 1930) The map, which is printed in colour, shows seven isohyets valued in centimetres It is based on the ten years' observations from 1911 to 1920 inclusive from more than six hundred stations ranging from Greenland and Spitsbergen to South Georgia and the South Orkneys A noteworthy feature of the map in which respect it differs from many other rainfall maps, is that the isohyets are not confined to the land areas but are carried across the oceans By the judicious use of island stations this method has been made possible without the risk of great inaccuracy The paper contains also a number of profiles of rainfall drawn across the world on every tenth parallel of latitude from 70° N to 60° S

A Steel Triangulation Tower —A portable but rigid steel triangulation tower which has been adopted by the United States Coast and Geodetic Survey is described by the inventor, Mr J S Bilby, in *Special Publication* No 158 of the Coast and Geodetic Survey The Bilby steel tower as it is now named consists of an inner tower 90 feet in height and an outer tower 100 feet in height The inner tower is to support the instruments and the outer tower to hold the observers' tent and a lamp for distant sighting The two are not connected, and each is fixed in 5 foot anchor posts Both are triangular in section and are built of galvanised steel rods of convenient length The total weight of the tower, including anchors and anchor sills, is not more than five thousand pounds The rigidity is such that a wind velocity of 20 miles per hour will not cause the top of the inner tower to vibrate in azimuth more than 10″ If necessary, one or more of the lower sections of the tower can be omitted when the full height is not required Full details of construction and anchoring are given in the pamphlet

New Magnetic Charts for France —In 1920 the Section of Terrestrial Magnetism and Electricity of the Geodetic and Geophysical Committee for France initiated a new magnetic survey of the country, which was commenced in 1921 and completed in 1927, the general tables of magnetic elements for the 1328 stations surveyed reduced to the epoch 1924 January 1 are now published in vol 7 of the *Annales de l'Institut de Physique du Globe de l'Université de Paris* The results are also embodied in a series of isomagnetic charts for the elements *D*, *I*, *H*, *F*, *X*, *Y*, *Z* The previous magnetic survey of France, undertaken by Moureaux, was referred to the epoch Jan 1, 1896, and comprised 617 stations In a brief description accompanying the charts, it is stated that the secular magnetic variation between 1896 and 1924 is by no means uniform over France, being, indeed (for *H*), twice as great in Brittany as at Paris A detailed discussion of this and related questions is to follow later

Calibration of Tuning-forks —The February number of the Bureau of Standards *Journal of Research* contains a paper by C Moon on the precise calibration of a tuning fork by comparison with a pendulum The comparison has been made photographically, the arrangement of apparatus being such that a single film records both the frequency and amplitude of the fork, and the amplitude of the pendulum, without affecting either the vibration of the fork or pendulum, or the driving mechanism of the fork The time taken by an integral number of vibrations of the fork has been determined to 20 microseconds, and the results exhibit quite definite small changes in the frequency of the fork consequent on changes in its amplitude

when the driving power is cut off The relation between frequency and amplitude is closely linear, the magnitude of the changes involved being such that a fall in amplitude of a heavy steel fork from 2 3 mm to 0 6 mm was accompanied by a rise in frequency from 99 976 to 99 984 cycles per second The results obtained have apparently reached the ultimate accuracy possible with this, or perhaps with any method, since there is evidence of lack of perfect isochronism in either the fork or the pendulum The irregularity is thought to be due to a variable rate of the pendulum caused by microseismic vibrations of the building, but it is unlikely that this can be eliminated by working elsewhere, since work carried out by the U S Coast and Geodetic Survey (in 1894) has shown that even in such an isolated place as the summit of Pike's Peak an initially stationary short pendulum rapidly takes up a slight oscillation, the magnitude of which, in the instances mentioned, was sometimes in the neighbourhood of two minutes of arc

Raman Effect and Chemical Structure—In a lengthy paper in the *Berichte der deutschen chemischen Gesellschaft* for February, Messrs Dadieu and Kohlrausch describe the method which they have used for measuring the Raman effect upon nearly a hundred compounds and discuss the bearing of the available data upon chemical constitution It is shown that certain well known chemical groupings are characterised by definite frequencies The last section deals with an attempt to find a suitable mathematical expression for the experimental results It is recognised that measurement of Raman frequencies gives us an excellent means of expressing accurately the effect of inter atomic vibrations within the molecule, since the disturbances measured are due to vibrations of atoms or atomic groups rather than to vibrations of molecules or electrons Moreover, the lack of sensitiveness to changes in physical state renders generalisation upon problems of constitution much simpler than is the case with such physical properties as absorption spectra or molecular refraction Amongst the compounds to which special attention is given are carbon monoxide and benzene Carbon monoxide is clearly differentiated from the carbonyl grouping in organic compounds, a fact which is adduced to support the view that the two atoms in the gas are held by a triple bond The structure of benzene has already given rise to much speculation in the past The evidence of the Raman effect is, on the whole, in favour of Kekulé's formula, since the frequencies which characterise all the various linkings in the skeleton C - CH - C are identified But benzene possesses an additional frequency, which apparently coincides with one associated otherwise only with normal paraffins This line disappears when a substituent enters the nucleus unless the structure of the substituent itself can produce it, and it is suggested (i) that it may owe its origin to the complete symmetry of the unsubstituted nucleus or (ii) that the six hydrogen atoms are not all equal in value, but that one of them is different from the rest The authors admit, however, that neither of these explanations is entirely satisfactory

Cost of Underground Electrical Mains—Electrical engineers have generally considered that the cost of underground mains for transmitting electrical power was much more expensive than overhead wires In a recent paper to the Overhead Lines Association, published in the *Electrical Times* for Mar 27, Dr Ekstrom gives costs which apparently prove that for pressures not exceeding eleven kilovolts—that is, the voltage which has been standardised for rural electrification in Great Britain—the underground mains may be much the more economical The saving is effected by using a special cable laying machine This machine consists of four parts A ditch digger which digs a trench 18 inches wide and any depth up to five feet, a belt conveyor which carries the earth dug up to a swinging spout behind the machine, where it is poured back into the trench, the truck carrying the cable, which is drawn by the digger and rolls down the loose earth, and the cable conveyor which carries the cable from the drum on the cable truck to the open part of the trench behind the digger The machine is driven by a four cylinder Diesel engine and its weight is so balanced that the uniform pressure on the earth under the caterpillar tracks is only 5 pounds per square inch Eight speeds are available, four for the work of cable laying and four for travelling The digger advances at rates varying from 200 ft to 300 ft per hour and is able to cover two miles per hour in travelling from place to place It is possible to lay a maximum of about one and a half miles of cable in an eight hour day The machine has been successfully used in Sweden and a film was shown of it in operation In making his computations, Dr Ekstrom assumes that the capitalised cost of wayleaves is about £32 per mile

Concentration of Hydrogen Peroxide—Whilst it is fairly easy to obtain hydrogen peroxide of moderate strength by evaporation methods, the production of 90 per cent material has so far involved rather complicated vacuum distillation In the March number of the *Journal of the American Chemical Society*, Hurd and Puterbaugh describe a method of obtaining concentrated peroxide which consists in adding to the aqueous material about twice its volume of an immiscible hydrocarbon such as xylene or *p* cymene With xylene, the commercial 3 per cent peroxide can be concentrated to about 30 per cent strength, whilst by using *p* cymene and distilling in vacuum the 30 per cent peroxide may be concentrated to 90 per cent The vacuum of an ordinary water pump was used, the water and hydrocarbon being distilled off and more than 60 per cent of the peroxide used being left in the flask in the concentrated state Most of the remaining peroxide is found in the distillate and 91 98 per cent recovery was obtained when the distillation temperature was kept below 57° The material could then be frozen to obtain pure peroxide

Atomic Structure—We have received from Dr W Tombrock, of Bergen op Zoom (Holland), an article which he has published on the chemical atom in the conception of discontinuous matter, in which the structures of hydrogen, helium, lithium, and carbon are discussed It is assumed that the electron is a material particle of larger volume and the proton a whirl in an ether composed of simple atoms The coupling of the protons in a chemical atom alone is explained in terms of the coupling of protons in a common path of secondary orbits of motion set up by the protonic whirls, these secondary orbits appearing as circular whirlwinds round the primary protonic centres of motion They at the same time explain the circular or elliptical motions of the spinning electron Representations of such proton couplings are given for hydrogen, helium, lithium, and carbon In the case of the carbon atom, the 12 protons are coupled in groups of three and have other mutual couplings The carbon proton triad must have become stable through its combination with three other triads, thus forming the configuration of the van 't Hoff tetrahedron Ether streams through inwards at the centres of the four faces and outwards at the four corners, or vice versa

Royal Society Conversazione

THE first conversazione this year of the Royal Society was held at Burlington House on May 14, and numerous specimens and pieces of apparatus were available for inspection by the fellows and their guests

The National Institute for Medical Research (Capt S R Douglas and Dr Wilson Smith) showed specimens illustrating the effects of infectious ectromelia, a hitherto undescribed virus disease of mice The disease was recognised by the occurrence of swelling, usually of one hind foot, followed by gangrene and separation of the affected portion of the limb The death rate is high, and post mortem examination shows changes of the liver and spleen Cytoplasmic inclusion bodies occur in the epithelial cells of the skin of the feet, and in glandular cells of pancreas and salivary glands The disease was investigated by Miss J Marchal, who found it to be due to a virus which, under certain conditions, constantly passes through filters which hold back bacteria

The Department of Zoology, British Museum (Natural History), had two exhibits Mr H W Parker and Lieut Col J Stephenson showed an example of parasitisation of the frog *Phrynomerus microps* by the Oligochaete worm *Nais bauchiensis*, which was recently described before the Linnean Society (NATURE, April 19, p 621) Mr G C Robson showed a model (× 2) of *Bathothauma lyromma*, Chun, a remarkable pelagic cephalopod *Bathothauma* is the most highly specialised of all the ten armed cephalopods The only known specimens were obtained in 3000 metres off the Cape Verde Islands by the *Valdivia* Expedition, and in the Pacific

The Rothamsted Experimental Station (Dr J Henderson Smith) had a demonstration of virus disease in plants Examples were shown (*a*) of the same virus in different host plants, (*b*) of different viruses in the same host plant, (*c*) of the combination of two viruses in the one plant The intracellular inclusions characteristic of many virus diseases in animals as well as plants were illustrated The movement of virus within the plant does not normally take place in the water or transpiration stream, or across dead tissues Prof H Raistrick showed apparatus used for the quantitative study of the metabolic products of the lower fungi About 400 species of the lower fungi have been grown on a synthetic medium containing glucose and mineral salts, and metabolic products arising from glucose were shown The Low Temperature Research Station, Cambridge, had exhibits illustrating the formation of methæmoglobin in red muscle and the control of fungal wastage in citrus and other fruits by storage in an atmosphere containing acetaldehyde The rate of oxidation of hæmoglobin to methæmoglobin in red muscle depends on the pressure of oxygen, and is a maximum when this pressure is small In a superficial layer of muscle, the oxygen pressure is determined by the rate of diffusion of oxygen into the tissue and the oxygen consumption of the tissue In consequence, the discoloration of red muscle produced by the formation of methæmoglobin can be controlled by alteration in the oxygen pressure of the gas surrounding the tissue The Forest Products Research Laboratory (Department of Scientific and Industrial Research) illustrated the use of anatomical methods in investigating the technical properties of timbers The magnified image of a transverse section of the sample of wood is projected on to a screen and a pointer moving across the field records on two scales according as it is moved over a group of fibres or over other elements Calculation gives the percentage of fibres in the sample

Dr and Mrs Pole Evans showed a striking collection of illuminated coloured transparent photographs of the natural vegetation of South Africa The photographs were coloured by hand by Mrs Pole Evans, and show natural vegetation scenes of grassland, forest, and desert, and included a number of photographs of the Kalahari, showing clearly that this region is anything but a desert in the commonly accepted sense In the desert scenes, the two most remarkable plants in southern Africa are shown (1) The plant commonly known as the 'Elephant's trunk' or 'half mens' (*Pachypodium namaquanum*) a unique plant which occurs in the mountains of the Orange River Valley, and (2) *Welwitschia mirabilis*, which is only found in the deserts of western Africa The John Innes Horticultural Institution had preparations showing the chromosomes of diploid and tetraploid plants of *Primula sinensis* and *P obconica* and others illustrating 'illegitimate' pollinations (pin eye with pin eye forms and thrum eye with thrum eye) in *P obconica* showing that the pollen tubes fail to enter the stigmatic tissue Preparations were also shown of chromosomes of *Pyrus Malus* The set of 17 is made up of seven types, four of which are represented twice and three three times This unbalanced polyploid condition explains some of the special properties exhibited by the group

The Department of Geology, British Museum (Natural History) (Mr A Tindell Hopwood), showed teeth of *Synconolophus* Osborn This genus of mastodons, found in the Lower and Middle Siwaliks of India, may have ranged so far west as the Isle of Samos, though the evidence is not clear, but it is not yet known from China or from Burma The Museum also showed a skull and feet of *Diceratherium Cooki* This rhinoceros had two horns side by side on the nose Various species have been found all over western Europe and North America, and this particular one from Nebraska was small, little larger than a pig, and with somewhat the same proportions

Mr R S Whipple showed an early Italian globe – believed to be the only example known It consists of two hollow hemispheres joined internally by 'bayonet' clips and measures 9 5 cm in diameter In a dedicatory inscription it is stated that the globe was engraved by Paolo de Furlani, a well known engraver and seller of maps at Venice in the second half of the sixteenth century

The Radcliffe Observatory, Oxford, exhibited photographs of the new planet discovered at the Lowell Observatory The two enlargements shown were from plates taken on Mar 29 and April 2 with exposures of an hour The instrument employed was the 24 in refractor by Grubb

Prof E N da C Andrade illustrated the mechanism of ridge formation in a sounding tube A sphere in a sounding tube is actually the centre of a vortex system, which governs the arrangement of neighbouring spheres Three tubes, excited by valve circuits were shown, (1) formation of ridges with particles of cork dust, (2) method of formation in more detail, with light spheres a few millimetres in diameter, (3) vortex system round a single sphere Messrs Adam Hilger, Ltd, showed spectrographic equipment, including apparatus for the observation of fine structure A photograph taken by Mr D A Jackson on

a reflection echelon of fused silica with the plates platinised was shown, the reflection echelon used is of the type suggested by Mr W E Williams in which the reflecting plates of fused silica are mounted in optical contact Number of plates—25, thickness of plates, 7½ mm The resolving power for wave length 4000 A is 913,000 There was also a Fabry Perot etalon of variable separation designed by Mr F Twyman, for measuring wave lengths in the longer wave length region of the spectrum in terms of the red cadmium line or other standard lines, and for observation of the fine structure of spectrum lines towards the red end of the spectrum A spectrogram from 1850 A to 3650 A, obtained on a perfectly flat photographic plate by means of an improved quartz lens system, designed by Mr J W Perry, was also exhibited The Research Laboratories of the General Electric Company (Mr J T Randall and Mr H P Rooksby) showed X ray photographs and crystal models illustrating the structure of vitreous and amorphous solids The passage of X rays through glass gives rise to broad diffraction rings or bands Some recent results (NATURE, Mar 22, p 458) indicate that these bands can usually be accounted for if it be assumed that the glass consists of very small crystallites

The Department of Mineralogy, British Museum (Natural History) (Dr L J Spencer), showed specimens of zinc blende from Tsumeb, South West Africa, which exhibited triboluminescence to a marked degree, even when under water, it also showed brilliant fluorescence when exposed to ultra violet rays The Research Department, Woolwich, illustrated a method for examining for flaws visually by means of X rays, long cylinders, such as gun tubes or gas cylinders A fluorescent screen is viewed at a distance and suspicious marks on the interior face of a long tube may be first identified by ordinary illumination and then by the interposition of a screen The same area may be irradiated by X rays and viewed on a fluorescent screen

The Solar Physics Observatory Cambridge, and the Cambridge Instrument Company, exhibited a recording microphotometer, designed for the study of spectrograms and photographs up to a size of 12 in × 10 in Light from an incandescent lamp is concentrated on to a minute area of the plate and the transmitted light falls on a slit over a photo electric cell The photo electric current passes through a Koch resistance cell and the potential across this cell is measured by a Lindemann electrometer The pointer of the latter is projected on to the camera (bromide paper 500 mm long × 120 mm wide), and its movements correspond to the density changes which are taking place in the plate as it is traversed The plate is mounted on a carrier with three degrees of freedom, the whole carrier being moved by a motor driven screw, which also rotates the drum of the camera, so that the movement of the latter bears a definite relation to the movement of the plate Two ratios are provided, 10 to 1 and 50 to 1 The part of the plate under examination can be viewed in a separate microscope while the record is proceeding Absorption wedges are provided, so that calibration lines can be made on the record or the density of any line measured by a null method Tracings were shown which give (a) an analysis of the shape of the absorption lines of sodium (D lines) in the solar spectrum, (b) an analysis of the shape of the absorption lines of hydrogen (Balmer lines) in stellar spectra, (c) distribution of illumination in the nebula N G C 3115, this being applied to form a contour map of brightness in the nebula The National Physical Laboratory had several exhibits The Physics Department showed a multiple thermoelement type hygrometer devised for use on ships carrying refrigerated cargoes The thermojunctions are housed in a metal casing attached to the end of a hose pipe and this is lowered down a thermometer tube A stream of air is drawn past the junctions by a suction fan attached to the other end of the pipe The Metrology Department showed apparatus for friction and wear tests on pivots and jewels The pivot is mounted in a vertical spindle, and supports a disc by means of a jewel mounted at the centre of the disc The disc can be maintained stationary by means of a magnet lying on the upper surface of the disc whilst the pivot rotates The apparatus has eight spindles, so that eight tests can be carried out simultaneously Wear of the pivot and jewel surfaces occurs as the pivot rotates, and this increases the torque due to friction between the pivot and jewel The apparatus can also be used to measure this torque at any time during the progress of a wear test The Wireless Division illustrated work which has been carried out for the Radio Research Board of the Department of Scientific and Industrial Research A demonstration was given by the projection of a spot of light on a screen of the frequency analysis of a modulated continuous oscillation The method of taking aural observations of bearings on the Orfordness rotating wireless beacon was demonstrated with the aid of a special stop watch The beacon signals can also be recorded automatically on a drum rotated synchronously with the beacon A 1 kilowatt two valve transmitter suitable for generating oscillations on wave lengths between 4 and 10 metres was shown, and also a simple portable two valve receiver suitable for reception work on the same range of wave lengths The Building Research Station (Mr A F Dufton) exhibited a microvolt hour meter for the investigation of the flow of heat at a window, into or out of a room (NATURE, April 26, p 635)

Sir Robert Hadfield exhibited numerous specimens illustrating special properties and applications of ferrous alloys An electric furnace was shown in operation with heating elements of the new R H * heat resisting alloy This alloy has the high electrical resistance of 134 microhms per c c at 20° C, with a low and uniform temperature coefficient of 0 000075 per °C, this combined with remarkable resistance to heat scaling By its means furnaces of the resistance type can be maintained continuously at temperatures as high as 1200° C Specimens were shown illustrating the difference in the effect of mechanical deformation on (a) manganese steel, (b) steel containing high percentages of nickel and chromium Both in their ordinary conditions are non magnetic, while, however, the non magnetic property of the former is unaffected by cold work, the latter is rendered fairly strongly magnetic Another exhibit was a specimen excavated from the base of the Khan Baba Column, in the Bhilsa district of Gwalior State, India, dating about 30 B C, certain portions of which contain no less than 0 70 per cent of carbon Upon heating to 830° C and quenching in water, the high carbon part acquired a glass scratching hardness, the Brinell hardness figure being 652, showing that no time effect wipes out this remarkable quality of hardening by quenching

Mr L S B Leakey demonstrated the Leakey-Harper drawing machine, originally designed to facilitate the detailed drawing of human skulls The machine is suitable for drawing any objects of which an accurate drawing is required, such as fossils, pottery, palæolithic instruments, etc Among other great advantages is the fact that drawings of several different views can be made without touching the object

Early Copper and Bronze in South Africa

TWO papers dealing with the primitive working of copper in South Africa, which were presented to Section H at the South Africa meeting of the British Association, are printed in full in vol 26 of the *South African Journal of Science* The late Dr P A Wagner and Mr Hugh S Gordon deal with material obtained from ancient smelters on the farm Blauwbank, No 435, in the Waterberg district of the Transvaal from which it was deduced that the ancient metallurgists had deliberately set out to make bronze Further as the original ingot found on the site some years ago and the prills of bronze here dealt with contain nickel and arsenic in notable amounts, it has been suggested that investigation might throw light on the date of these workings in view of the fact that ancient bronze from Egypt and Mesopotamia contains nickel, and yet no very ancient site is known which could have produced the ore required to make a nickeliferous bronze

Further investigations have established the existence at Blauwbank of no fewer than forty smelting sites, two different types of furnaces, and at least four different types of slag proving that tin, iron, copper, and bronze were smelted there Chemical analysis of eleven of the supposed bronze prills and brods prove that some of them are of fairly pure copper, others of arsenical copper and copper spice, while only two contain enough tin to bring them within the definition of true bronze, and these are so rich in arsenic that the application of the term is scarcely warranted Nearly all contain some percentage of nickel The analysis of a bronze bangle from Zimbabwe also contains nickel As other bronzes from Zimbabwe and a piece of bronze from Rooiberg, found by Dr Frobenius, also contain nickel, it is possible that further investigations may show a connexion between Blauwbank and Rhodesia, especially as no ancient tin workings are known in Southern Rhodesia

On the other hand, Mr G H Stanley in a paper on "Primitive Metallurgy in South Africa", while admitting that the specimens he has examined point to a deliberate admixture of tin and copper, holds that the copper ingots are of recent native origin The specimens from Zimbabwe which were examined were in part from the Rhodesia Museum, Bulawayo, in part specimens submitted by Miss Caton Thompson from her excavations at Zimbabwe and other ruins of Rhodesia The museum specimens from Zimbabwe itself were typical tin bronzes approximating so closely to the 90 10 ratio that in all probability they were made by melting together previously smelted copper and tin No nickel was found in any, though there were traces of cobalt The metal was of excellent quality and obviously produced by skilled smelters from very fine ores Of the specimens from other sites, a slug from Renders Ruin was almost pure copper, while a bangle from Niekerk Ruins, Inyanga, contained less tin and more arsenic than the rest A spear head from Dhlo Dhlo was of intermediate position, but with neither nickel nor cobalt in detectable quantities

Miss Caton Thompson's specimens—small objects, bangles and the like—exhibited a peculiar blue green patina which suggested enamel It was, however, easily removable by dilute hydrochloric acid, leaving a very roughly corroded surface A bangle gave the analysis copper 87 43, tin 12 3, iron 0 08, nickel nil, cobalt faint trace A spherical pellet 1 4 cm in diameter showed copper 98 87, tin 0 8, bismuth 0 01, nickel nil, cobalt nil Other bangles gave an analysis of copper 89 57, tin 10 5, and a piece of thin bronze plating gave approximately the same

Excepting a brass, the only specimen to show a notable content of nickel was a specimen from Chiwona, an irregular flattened lump of metal weighing about 110 gm, evidently a smelting product The analysis was copper 96 3, arsenic 1 78, tin trace, iron 0 42, nickel 1 2, cobalt slight trace

Mr Stanley maintains that the presence of nickel is exceptional rather than characteristic Nickel is quite a common accompaniment of copper in ores of the latter, but unless its presence is commercially important, it is not usually determined or reported The analyses of ancient copper objects from Sumeria published by Prof Desch show only four with nickel exceeding 0 25 per cent the richest being 3 3 Copper and bronze objects of ancient Egyptian and Babylonian origin seldom show the presence of nickel beyond what might be considered an ordinary impurity In regard to the possibility of South Africa having been the source of ancient bronzes showing traces of nickel, he holds that such ores might have been obtained from a number of other centres, such as the Caucasus or Asia Minor, where a number of ancient workings are known, and others are probably still undiscovered

University and Educational Intelligence

CAMBRIDGE —The Ministry of Agriculture and Fisheries has offered to make a grant not exceeding £8500 in aid of the provision of additional laboratory accommodation at the field station of the Department of Animal Pathology in the University

The Appointments Committee of the Faculty of Economics and Politics has appointed E A G Robinson, of Corpus Christi College, to be University lecturer in the faculty

The Council of the Senate has recommended the establishment of a temporary professorship of colloidal physics for three years, and that the professorship be held in the first instance by Dr E K Rideal, of Trinity Hall

It is proposed to confer the honorary degree of doctor of science on Prof A Einstein, Prof M Planck, and Sir John Rose Bradford

At a special congregation of the Senate on May 17, the Right Hon Stanley Baldwin was elected Chancellor of the University in succession to Lord Balfour, who died on Mar 19

LEEDS — The Corbet Woodall scholarship in gas engineering, value £60 a year, and tenable for three and possibly four years, is being offered for competition Applications must reach the Clerk to the Senate, the University, Leeds, by June 2

LONDON —Presentation Day at the University was on May 14, the ceremony taking place in the Albert Hall The new Chancellor, Lord Beauchamp, who presided for the first time, referred in his charge to the new graduates to the re constitution of the University under the Act of 1926 In the course of next year, he said, it might be expected that the foundation stone would be laid of the buildings on the Bloomsbury site, into which the University would enter in its centenary year (1936) Another important development to which the Chancellor specially referred was the provision of a hall of residence for students The new Principal, Dr E Deller, in his Report, also referred to the re constitution "There are still some matters outstanding—the revision and (it is hoped) the simplification of our regulations, and the delegation of powers are examples—but satisfactory progress is being made" The total number of candidates for

all examinations, the Report stated, was 36,633 as against 11,937 in 1913 and 34,941 last year The candidates for first degrees were 3436 and for higher degrees 510 Of the 3436 candidates for first degrees, 2458 were internal and 1488 external students There are now 10,200 internal students Nothing of outstanding scientific interest is included in the Report, but among recent developments reference is made to the establishment of the University Observatory at Mill Hill Park and to the institution of a chair of social biology at the London School of Economics

MANCHESTER —Notice is given of the offer of a Grisedale research scholarship in either botany or zoology, the value of which is £200 Applications should reach the Registrar of the University by June 2 at the latest

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SIR WALTER BUCHANAN RIDDELL, principal of Hertford College, Oxford, has been appointed by the Lords Commissioners of the Treasury to be chairman of the University Grants Committee in succession to the late Sir William McCormick

AN examination of candidates for the associateship of the Institute of Physics will be held in September next Applications for entry for the examination must be received by the Secretary of the Institute, 1 Lowther Gardens, S W 7, not later than July 31

A FELLOWSHIP of the annual value of £300, and tenable for two years, is being offered by the Company of Armourers and Brasiers, for research in aeronautics Applications, upon a form obtainable from the Clerk, Armourers' Hall, 81 Coleman Street, E C 2, must be sent in by, at latest, May 30

THE Empire Cotton growing Corporation is offering a number of (a) specialist studentships, and (b) agricultural studentships, particulars as to the tenure and value of which may be obtained from the Secretary of the Corporation, Millbank House, 2 Wood Street, S W 1 The Specialist Studentships are intended to enable graduates who believe that they have a leaning towards research to equip themselves for posts in which work of that type is required The Agricultural Studentships are intended to enable men to receive specialised instruction to equip them for agricultural posts in cotton growing countries, whether in Government Agricultural Departments, with commercial cotton growing companies, or under the Corporation Completed forms of application must reach the Corporation by June 4

THE Council of the Institution of Electrical Engineers has established the following scholarships, the first awards of which will be made this year *Duddell Scholarship* (annual value £150, tenable for 3 years) Each candidate must be nominated (not later than June 15) by a corporate member of the Institution The award is open to British subjects less than nineteen years of age on July 1, who have passed the matriculation examination of a British university or an examination exempting from matriculation *Ferranti Scholarship* (annual value £250, tenable for 2 years) Each candidate must be nominated (not later than Aug 15) by the professor or teacher under whom he is working or has worked The award is open to British subjects less than twenty six years of age on July 1 who are students or graduates of the Institution of not less than two years' standing Particulars can be obtained from the Secretary of the Institution, Savoy Place, London, W C 2

Historic Natural Events

May 25, 1269 Prolonged Winter —The winter of 1268–69 was very rigorous in Great Britain, northern Europe, and Germany In Alsace it was prolonged until May 25 Holinshed (1578) records that "an exceeding great frost began at St Andrew's tide (Nov 30) and continued till near Candlemas The Thames, from the bridge upwards, was so hard frozen that men and beasts passed over Ships could not enter the Thames, so merchandise was brought to London from Sandwich and other places by land" The Baltic was frozen between Gothland and the Swedish coast

May 25, 1686 Hailstorm at Ryssel (Lille) —Hailstones fell at Lille weighing from one quarter to one pound or more on May 25, 1686 One had dark brown matter in the middle, which when thrown into the fire gave a loud report The others were transparent and melted immediately The storm passed over the citadel and town, and not a pane of glass was left on the windward side Trees were broken and beaten down, and partridges and hares were killed in abundance

May 26, 1916 Eruptive Solar Prominence —A remarkable eruptive prominence, reaching the unprecedented height of 18′ (about 500,000 miles) above the sun's limb, was photographed in India with the spectroheliographs at Kodaikanal and Srinagar Between $8^h\ 6^m$ and $9^h\ 9^m$ (Indian Standard Time) the prominence rose with increasing velocity from a height of 130″ to 15′ At $9^h\ 9^m$ the bulk of the prominence had suddenly disappeared, leaving a group of bright points at a height of 13′ to 17′, at $9^h\ 22^m$ or about $1\frac{1}{4}^h$ after the first photograph, this small group of points was faintly visible 16′ to $18\frac{1}{4}$′ above the sun's limb The general movement of ascent of the prominence ranged from 80 km /sec to 290 km /sec whilst the greatest velocity of movements of points within it was 450 km /sec It may be remarked that this great eruption occurred outside the sunspot zones

May 28, 1856 Rhone Floods —Serious flooding existed in the upper Rhone and especially the Saone on May 11–20, and the waters had scarcely begun to fall before another flood set in on May 24–26 On the evening of May 28 a general heavy fall of rain began and continued for nearly forty eight hours, at several places totals of more than 4 inches in twenty four hours were recorded The floods of the Drac, the lower Isère, the upper Danube, and the Rhone at Lyons, exceeded all records, and persisted for thirty-six hours The level rose 30 feet above normal at Beaucaire, all the dykes were broken, many bridges were carried away, and the low lying parts of Lyons on the left bank were partly destroyed An enormous area was flooded between Tarascon and the sea, and all the crops were ruined

May 29, 1613 Cloudburst —An enormous 'cloud burst' occurred in Thuringen, lasting eleven hours, and was followed by unparalleled floods, remembered for a century under the name of the "Thuringian Deluge" At the same time there were great floods in Saxony, Bohemia, and Austria

May 29, 1919 Great Eclipse Prominence —A great arched prominence, nearly 300,000 miles in length and more than 100,000 miles in height, was a conspicuous naked eye object within the corona during the total solar eclipse of May 28–29—the occasion when the displacement of a ray of light caused by the gravitational field of the sun (as predicted by Einstein) was first measured This prominence, as shown by spectroheliograms taken at Cambridge, Kodaikanal, and Yerkes, had been in existence since Mar 22, and at the time of the eclipse

it was coming into view around the sun's east limb. Shortly after the eclipse had been observed in South America (about 2h G.M.T.) the prominence, hitherto of a stable character, became eruptive, and by 8¼h G.M.T. had risen to a height of more than 450,000 miles, after which it suddenly dissipated. The two columns from which it arose in latitudes 37° and 41° S. were seen at each return to the sun's limbs for two months after the eclipse.

May 29, 1920. Louth Floods.—A thunderstorm of unusual severity broke over Lincolnshire during the afternoon, accompanied by exceptionally heavy rain over the Wold country to the west and south-west of Louth. At Elkington Hall, 3 miles west of Louth, 4·69 in. was measured, of which 4·59 in. fell in three hours, and at Hallington two miles to the southward it is estimated that 6 inches fell in three hours. The river Lud rose 16 feet in fifteen minutes and a deep torrent 200 yards wide swept through the town. The damage done in Louth alone was estimated at £100,000, while the flood came as a complete surprise to most of the inhabitants who were sheltering indoors, and 22 persons were drowned. The flood was probably accentuated by the blocking of the valley by débris at a bridge just above Louth.

May 29, 1928. Shower of Fish.—Dozens of tiny red fish were found on the roof of a bungalow at Drumhirk, near Comber, Ireland, and on the ground in the vicinity. Just before the discovery of the fish there had been an exceptionally violent thunderstorm with heavy rain. There is no river in the neighbourhood, the nearest sheet of water being Strangford Lough, 2 miles distant, and it was believed that the fish had been lifted from the sea by a waterspout.

May 31, 1911. Thunderstorm at Epsom on Derby Day.—The severest thunderstorm and heaviest rainfall since records started in 1905 occurred between 5 P.M. and 8 P.M. at Epsom on May 31, 1911. The day had been humid and close, with a thunder haze gathering about 3 P.M. Thunder was heard and at 5 P.M. three distant storm centres became apparent north and north-east, north-west, and south to south-west. Two cloud currents were visible at 5 P.M., an upper one from south-west, and a lower one from north-east. Fork lightning and thunder were practically continuous. The thunder was in sharp decisive cracks, and the lightning of dazzling intensity. At 5.30 P.M. the north and south centres coalesced, and rain commenced falling in a torrent at 5.20 and continued until 6.0, 2·44 in. falling in fifty minutes. The thunder ceased at 7.59 P.M. but the lightning remained visible until 9.30 P.M. Seventeen people and four horses were killed, and three hayricks fired by lightning.

Societies and Academies.

LONDON.

Royal Society, May 15.—**M. L. E. Oliphant** and **P. B. Moon**: The liberation of electrons from metal surfaces by positive ions. When helium ions strike a metal surface they liberate electrons, the number depending upon the metal and the condition of its surface. Velocity distribution of electrons, liberated from a clean surface of molybdenum by positive ions of helium, shows a sharp cut-off at a lower limit of 2·3 volts, and a sharply defined upper limit at 20·2 volts. Maxima were observed in experimental curves at 2, 5, 6·8, 17·0, and 20·0 volts. The results can be explained quantitatively on the basis of modern theories of the metallic state.—**O. W. Richardson** and **U. Andrewes**: A comparative study of the excitation of soft X-rays from single crystal surfaces and from polycrystalline surfaces of graphite and aluminium. The curves obtained by plotting the photoelectric yield of the soft X-rays per unit thermionic current against the exciting primary voltage show discontinuous rates of increase at certain voltages which coincide with those which give similar discontinuities with the polycrystalline specimens. They are, however, fewer in number and tend to run in groups. The voltages at which the discontinuities occur appear to have a numerical structure resembling that which connects the null frequencies of band systems. The crystal curves are steeper at moderate voltages and flatter at high voltages than the polycrystalline curves.—**O. W. Richardson** and **S. Ramachandra Rao**: (1) The excitation of soft X-rays from some polycrystalline metal surfaces. Measurements have been made of large numbers of soft X-ray critical potentials for cobalt, nickel, tungsten and pure and also impure copper. Variation of photoelectric yield with magnitude of thermionic current and with inclination of anticathode is examined. Many of the inflections only appear after the targets have been heated to a high temperature.—(2) The excitation of soft X-rays from a single crystal face of nickel. The soft X-ray critical potentials for the 100 face are less numerous than for polycrystalline nickel. The total yield is also lower at high and higher at low voltages with the crystal specimen.—**S. Ramachandra Rao**: (1) Total secondary electron emission from polycrystalline nickel. Applied potentials from 1 to 550 volts were used. Several peaks are obtained below 30 volts and a large number of inflections above 30 volts. The effect of bombarding in hydrogen is also studied.—(2) Total secondary electron emission from a single crystal face of nickel. The potentials at which inflections appeared agree very well with the soft X-ray discontinuities from the same crystal face obtained by Richardson and Rao. The bearing on soft X-ray discontinuities is discussed.—**O. W. Richardson**: The emission of secondary electrons and the excitation of soft X-rays. The first act seems to be the excitation of a *structure* electron by the primary which is returned as part of the high energy group of secondaries. The low energy group and the X-rays result from the return of the excited structure electrons to the ground state. The agreement of the soft X-ray with the secondary electron breaks is accounted for since both are excitation potentials of the structure electrons. The hypothesis gives a natural explanation of the band-like structure of the discontinuities already found empirically for C and Al and here extended to Ni.—**W. A. Bone**, **L. Horton**, and **S. H. Ward**: Researches on the chemistry of coal (6). The main coal substance can be readily oxidised by means of alkaline permanganate to carbonic anhydride, acetic, oxalic, and benzene carboxylic acids; about one-third of the carbon of the coal substance appeared in C_6 rings of benzenoid acids. Under 'optimum conditions' the character and proportions of the various oxidation products do not vary much with the maturity and geological age of the coal, and colloidal 'humic acids' are formed as intermediate oxidation products. The constituents of bituminous coals mainly responsible for their 'coking propensities' are benzenoid in character, and in all probability during the 'maturing process' they developed from phenols and phenolic esters, found in immature brown coals. On carbonising coals at various temperatures up to 1000° C. their proportionate 'benzenoid' structure first increases, attaining a maximum at about 500°–600° C., but afterwards diminishes, although a completely 'carbonised' coke still retains some of it.—**L. Rosenhead**: The spread of vorticity in the wake behind a cylinder. The trail of vortices in the wake behind a cylinder is taken to be a symmetrical double row of rectilinear vortices of circular

section The stability of such a system to three dimensional disturbances is investigated There is also a discussion of the stability of an isolated recti linear vortex of circular section to three dimensional disturbances —L J Freeman The spectra of trebly ionised oxygen (O IV) and trebly ionised nitrogen (N IV) About 50 lines in the spectrum of trebly ionised oxygen (O IV) have been newly classified All the doublet and quartet terms of principal quantum number 3 have been identified In the spectrum of trebly ionised nitrogen (N IV), combinations of the $3p$ term with $3s\ ^3S$ and $3d\ ^3D$ have been observed Provisional classifications have been given for four other lines —G Temple (1) The group properties of Dirac's matrices An account of the group properties of a set of operators (A_1, A_2, A_3, A_4), with operand ψ, particularly with reference to a generalised form of Dirac's wave equation

$$\sum_{s}^{4} p_s A_s \psi + (2\pi i m c/h)\psi = 0,$$

in which the A's are not restricted to be matrices (2) The operational wave equation and the energy levels of the hydrogen atom Dirac's methods can be modified and generalised to suit an extension of his linear wave equation based on the preceding paper, which is applied to the problem of the undisturbed hydrogen atom It proves possible to obtain the energy levels, quantum numbers, and wave functions —J Hargreaves The effect of nuclear spin on the optical spectra (3) The interaction energy of the nuclear and electron magnets is calculated for the cases of nuclear spins of ½, 1, 1½, and 4½ quanta A description is also given of the hyperfine structure of the Zeeman effect, and it is found that the 'cosine' law holds The results agree very well with observations for bismuth

Geological Society, April 30 —**Emily Dix** and **A E Trueman** Some non marine lamellibranchs from the upper part of the coal measures The higher part of the *Pulchra* Zone and in the *Phillipsi* and *Tenuis* Zones are discussed Nearly all the shells found in these higher measures are members of the genus *Anthracomya*, and most of them are related to the group of *A phillipsi*, but there is evidence that another group, represented by shells which resemble *A lanceolata* Hind, occurs more rarely at widely separated horizons The sequences determined in many British coalfields are remarkably similar, and reasons are advanced for the view that at certain periods in the late Carboniferous Period there was considerable uniformity in the conditions over large parts of Britain There are also great similarities in the sequence in the upper part of the Westphalian of the Continent —**Emily Dix** The flora of the upper portion of the Coal Measures of North Staffordshire The paper deals with the distribution of fossil plants in the Upper Coal Measures, and in the upper part of the Middle Coal Measures of North Staffordshire above the horizon of the Ash Coal Few plants have hitherto been recorded from the measures for some distance below the Bassey Mine Ironstone, and the chief purpose of this paper is to give an account of these measures with the view of determining the horizon which marks the entrance of the Staffordian flora in North Staffordshire For some hundreds of feet below the Bassey Mine Ironstone the measures yield a flora in which Radstockian and Yorkian species are mingled, and therefore it is concluded that the base of the Staffordian should be drawn below the Chalky Mine Ironstone, about 400 feet below the Bassey Mine Ironstone This conclusion is of importance in the correlation of such areas as South Wales, Staffordshire, and Somerset by means of fossil plants

Society of Public Analysts, May 7 —**L H Lampitt**, **E B Hughes**, and **H S Rooke** The diastatic activity of honey Honey diastase behaves in a similar way to other enzymes under varying conditions of temperature and pH, the optimum pH for both the dextrinogen amylase and the saccharogen amylase being about 5 3 —**A R Powell** and **W R Schoeller** A new method for the separation of titanium from zirconium and hafnium The method is based on the precipitation of the titania by tannin from a neutralised oxalate solution half saturated with ammonium chloride a repetition of the procedure results in the quantitative precipitation of the titania with only traces of zirconia, if any —**E R Bolton** and **K A Williams** The composition and polymerisation of Chinese wood (tung) oil The authors confirm the value of Toms's method of determining the elæostearic acid in tung oil by the difference between the iodine value obtained by the bromine vapour and that obtained by the action of Wijs solution until four of the six bonds are saturated The elæostearic acid glyceride corresponded with the amount of polymerisable matter separated by the authors' method of extraction, and for the oils examined ranged from 70 to 74 per cent —**D R Wood** The examination of milk for tubercle bacilli A survey is given of the experience and results obtained in the examination of 1000 herds in the County of Somerset during the last four years Present methods are inadequate for the elimination of tuberculous milk

DUBLIN

Royal Dublin Society, April 29 —**J Reilly**, **R Wolter**, and **P P Donovan** Study of the polysaccharides (3) Acetamide as a polysaccharide solvent —**J H J Poole** A new form of recording galvanometer A transparent scale about 4 cm long at a distance of about 10 cm is employed instead of the usual 50 cm scale at 100 cm distance A small lamp with a condensing lens behind the scale illuminates the latter uniformly After reflection in the galvanometer mirror, which is preferably plane, an image of a short portion of the scale is formed on a film of a Baby Pathe kinematograph camera at a convenient distance—say 20 cm —by means of a good lens A fine wire almost in contact with the film casts a shadow the reading of which on the scale measures the galvanometer deflection A mechanical device which causes one exposure per minute (or at any other convenient interval) enables a permanent record to be obtained The method is cheaper than the more usual revolving drum apparatus as it employs standard commercial articles The camera may be replaced by an eyepiece with cross wires for direct observation The method is then well adapted for observing the deflections of sensitive portable galvanometers for outdoor work In this case the lamp and condensing lens may generally be omitted and the scale illuminated by daylight

PARIS

Academy of Sciences, April 7 —**Ernest Esclangon** The new celestial body discovered at the Lowell Observatory Data worked out from photographs taken at the Paris Observatory between Mar 26 and April 4 —**H Deslandres** A new cause which intervenes in increasing or modifying the intensity of lines and bands in the spectra of atoms and molecules —**Marcel Brillouin** Dynamical tides with continents The law of any depth Attraction of the ring —**Charles Richet** and **Michel Faguet** The action of irradiated sea water on lactic fermentation After ten minutes irradiation, there is an acceleration of the fermentation as measured by the acidity produced

after thirty minutes irradiation there is an inversion, no acceleration being produced —**C Gutton** The properties of ionised gases in electromagnetic fields of high frequency The observations described confirm the explanation given by H Gutton of the results of his researches It is suggested that the formula of Eccles and the theories based on it require modification —**E Mathias** The conception of Stephen Gray on the identity of lightning and the sparks of electric machines In one respect the view of Stephen Gray is imperfect, lightning transports only positive electricity, whereas the induction spark is formed of two discharges in opposite directions —**L Léger** *Sphærospora pernicialis*, a new Myxosporidium pathogenic to the tench —**J Dieudonné** The roots of algebraic equations —**L Escande** The excess pressure caused by the stopping of a motor pump group in a water main —**F Baldet** The calculation of the photometric diameter of the celestial body of the Lowell Observatory (see NATURE, May 3, p 672) —**Jean Jacques Trillat** Researches on the internal and superficial structure of organic liquids with long chains The results of an X ray study, with special precautions against the errors due to the presence of a halo arising from the filtration of the continuous background In several cases, the superficial structure of liquids differs from the internal structure, as a result of a statistical orientation of the molecules The results of McBain and of Hardy are confirmed —**H Mutel** The measurement of the effective intensity of high frequency currents Experiments with a differential ammeter consisting of two glass tubes arranged as arms of a differential air thermometer with a fine platinum wire in the axis of each One carries the high frequency current and is balanced by a direct current Even after correction for the skin effect for very high frequencies there is an error due to the heating of the heat insulation material by the high frequency electromagnetic field —**J Urbanek** The diffusion of light by polished surfaces A description of a photographic method serving to characterise the perfection of polishing of a vitreous surface —**C Marie and Gérard** The electrolytic deposit of copper in the presence of amino acids Copper deposited electrolytically from a solution of copper sulphate containing glycocoll, contains both copper sulphate and the amino acid Leucine behaves similarly —**Guy Emschwiller** The photolysis of the organic iodides the influence of temperature The temperature coefficient of the photolysis varies with the nature of the radiation The phenomena are complicated and experimental verification of the theories suggested to explain the existence of a temperature coefficient of photochemical reactions is difficult —**Augustin Boutaric and Mlle Geneviève Perreau** The flocculation produced by the mixture of two colloidal solutions of the same nature but the granules of which have opposite electric signs —**F Bourion and Mlle O Hun** The determination, by the boiling-point method, of the molecular equilibria of pyrocatechol in solutions of potassium and sodium chloride —**J Golse** The action of silver nitrate on solutions of potassium mercuric iodide —**A Travers and Avenet** The estimation of phenols in coke oven effluents —**Albert Kirrmann and Jean Grard** An abnormal reaction of the dihalogen propylenes 1, 3 dibromopropylene, in a previous communication, has been shown to react in an anomalous manner with organo magnesium compounds the 3, 3 dichloro propylene is now found to behave similarly —**Roger Dolique** The normal *n* butylbenzyl and dibenzyl ethyl alcohols, the isomers methyl *n* butylbenzyl and ethyldibenzylcarbinols —**Mlle M Cabanac** The catalytic decomposition of some acetals of the fatty series by metallic oxides Diethylacetal, at 400° C in the presence of thoria, gives the unsaturated ether $CH_2=CH \cdot O \cdot C_2H_5$ (13 per cent) together with aldehyde, alcohol, and a gaseous mixture of ethylene, hydrogen, carbon monoxide, carbon dioxide, and methane —**Albert Nodon** The effects of ionisation by solar action — **H Colin and E Guéguen** The seasonal variations of the proportion of sugar in the Florideæ — **H Belval** The transformations of the glucides in the banana the formation of starch in the fruits —**Mlle Germaine Py** The evolution of the cytoplasmic constituents during the formation of pollen grains and of the nutrient layer in *Senecio vulgaris* —**F Maignon and Ch Grandclaude** The hardening action of intravenous injections of glycerol Sensitising effects of a single injection —**L Lutz** The soluble ferments secreted by the Hymenomycetes fungi Hydrolysis of the hemicelluloses —**A Paillot** Bactorial parasitism and symbiosis in *Aphis mali*

Official Publications Received

BRITISH

Proceedings of the Royal Irish Academy Vol 39 Section B Nos 14 15 Azo Dyes derived from Diacetoresorcinol by Dr Joseph Algar and Mary Boylan The Action of Grignard Reagents on Phthalide by Dr Joseph Algar and Albert V Flaegel Pp 343 357 (Dublin Hodges, Figgis and Co London Williams and Norgate Ltd) 6*d*

The Indian Forest Records Silvicultural Series Vol 15 Part 2 A Glossary of Technical Terms for use in Indian Forestry (Adopted for Official Use by the Silvicultural Conference Dehra Dun March 1929) Pp iii+30 (Calcutta Government of India Central Publication Branch) 6 annas 8*d*

The Himalayan Journal Records of the Himalayan Club Edited by Kenneth Mason Vol 2 April Pp vi+206+16 plates (Calcutta Thacker Spink and Co London W Thacker and Co) 5 rupees 8*s*

Union of South Africa Department of Agriculture Science Bulletin No 85 Structure of the Cortex of Grass Roots in the more Arid Regions of South Africa By Dr M Henrici Pp 1? 3*d* Science Bulletin No 87 The Bacterial Wilt Disease of Peanuts (*Arachis Hypogaea* L) By A P D McClean Pp 14+7 plates (Pretoria Government Printing Office)

Union of South Africa Report of the South African Museum for the Year ended 31st December 1929 Pp 16 (Pretoria Government Printing Office)

Rhodesia Museum Bulawayo Twenty eighth Annual Report 1929 Pp 16 (Bulawayo)

Department of Scientific and Industrial Research Forest Products Research Project 1 Progress Report 2 Tests of some Home grown Timbers in their Green and Seasoned Conditions By C J Chaplin and F M Mooney Pp iv+9 (London H M Stationery Office) 1*s* net

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1318 (E 32) Torsional Vibration of Crankshafts A Description of the R A E Mk III Torsiograph By the Staff of the Engine Experimental Department Royal Aircraft Establishment (I C E 890) Pp 5+6 plates 1*s* net No 1222 (Ae 402) Flow through Pipe Orifices at Low Reynolds Numbers By F C Johansen (T 2797) Pp 24+14 plates 1*s* 9*d* net (London H M Stationery Office)

Stonyhurst College Observatory Results of Geophysical and Solar Observations 1929 with Report and Notes of the Director Rev E D O'Connor Pp xx+50 (Blackburn)

University Grants Committee Report including Returns from Universities and University Colleges in receipt of Treasury Grant Academic Year 1928–29 Pp 74 (London H M Stationery Office) 3*s* 6*d* net

The Scottish Forestry Journal being the Transactions of the Royal Scottish Arboricultural Society Vol 44 Part 1 March Pp xx+48+26+50 (Edinburgh) 7*s* 6*d*

FOREIGN

Report on Norwegian Fishery and Marine Investigations Vol 3 No 10 The Propagation of our Common Fishes during the Cold Winter 1924 Investigations on the Norwegian Skagerrack Coast By Alf Dannevig Pp 133 (Bergen A S John Griegs Boktrykkeri)

Instituts scientifiques de Buitenzorg " 's Lands Plantentuin " Treubia recueil de travaux zoologiques hydrobiologiques et oceanographiques Vol 11 Livraison 3 Fevrier Pp 301 371+plates 6 11 (Buitenzorg Archipel Drukkerij) 2 50 f

U S Department of Commerce Coast and Geodetic Survey Serial No 457 Magnetic Declination in Delaware Maryland Virginia, West Virginia, Kentucky and Tennessee Pp iii+112 (Washington, D C Government Printing Office) 20 cents

Field Museum of Natural History Anthropological Series Vol 19, No 1 Melanesian Shell Money in Field Museum Collections By Albert B Lewis (Publication 268.) Pp. 36+25 plates Zoological Series, Vol 17, No 5 A Study of the Tooth billed Red Tanager *Piranga flava* By John T Zimmer (Publication 269) Pp 167 219 Botanical Series, Vol 7, No 1 The Rubiaceae of Colombia By Paul C Standley (Publication 270) Pp 175 (Chicago)

Smithsonian Institution United States National Museum Contributions from the United States National Herbarium Vol 24 Part 9 The Grasses of Central America By A. S Hitchcock Pp. v+557 762+vii xvi (Washington, D C Government Printing Office.) 35 cents

Cornell University Agricultural Experiment Station, Ithaca New York Bulletin 490 Abandoned Farm Areas in New York By Lawrence M Vaughan Pp. 285 Bulletin 491 Varietal Experiments with Soy beans in New York By R G Wiggans Pp 19 Bulletin 493 Village Service Agencies, New York, 1925 By Bruce L Melvin Pp 117 Bulletin 494 Some Facts concerning the Distribution of Fruits and Vegetables by Wholesalers and Jobbers in Large Terminal Markets By M P Rasmussen Pp 115 Bulletin 495 Apple Varieties Prices Yields and Acreages By G P Scoville and T E LaMont Pp 104 Bulletin 496 An Economic Study of Farm Electrification in New York with a Discussion of Rural Electrification in the Provinces of Quebec and Ontario, Canada By R F Buckman Pp 6 Bulletin 497 Pollination and other Factors affecting the Set of Fruit, with special reference to the Apple By L H MacDaniels and A J Heinicke Pp 47 Bulletin 498 Protecting Orchard Crops from Diseases and Insects By C R Crosby W D Mills and W E Blauvelt Pp 80 Memoir 125 Inheritance and Linkage Relations of Virescent Seedlings in Maize By I F Phipps Pp 63 Memoir 126 Effect of Storage in finely divided Feeds upon the Stability of the D Vitamin of Cod Liver Oil By L C Norris G F Heuser and H S Wilgus Pp 15 (Ithaca, N Y)

Yale University Report of the Director of Peabody Museum 1928 1929 Pp 24 (New Haven Conn)

CATALOGUES

Catalogue of Botanical Works from the Library of a noted British Botanist recently deceased containing many Continental British, Irish and Scotch Floras and serial Publications also some Rare Herbals and Horticultural Works (No 12) Pp 16 (London John H Knowles)

Elixir Vellbrom B D H and Elixir Vallbrom Compound B D H Pp 4 (London The British Drug Houses Ltd)

Scientific Books and Publications of Learned Societies (Catalogue 348) Pp 74 (Cambridge W Heffer and Sons Ltd)

Diary of Societies

FRIDAY, MAY 23

PHYSICAL SOCIETY (at Imperial College of Science and Technology) at 3 and 5 15 —*Discussion on Magnetism* —Sir Alfred Ewing Ferro Magnetism and Hysteresis —Dr E C Stoner Magnetism in the 20th Century —Prof H S Allen Magnetism and the Quantum Theory — Prof C G Darwin The Polarisation of the Electron —W Sucksmith The Gyromagnetic Effect and Paramagnetism —F C Powell On the Change in Size of a Ferromagnetic at the Curie Point —Prof W Peddie Magnetisation and Temperature in Crystals —Prof W Weiss and Dr R Forrer Sur l'aimantation à saturation des ferrocobalts et des nickel cobalts et les moments atomiques des trois métaux —Prof W Gerlach Über neue Zusammenhänge von magnetischen u elektrischen Erscheinungen —Dr P Kapitza Methods of Experimenting in Strong Magnetic Fields —Dr W L Webster On Magnetostriction and Change of Resistance in Single Crystals of Iron and Nickel —Dr L F Bates Observations on the Specific Heats of Ferromagnetic Substances

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Edinburgh and East of Scotland and Glasgow Sections of Society of Chemical Industry) (at Heriot Watt College, Edinburgh), at 6 —Prof J Kendall Chemistry in Naval Warfare

ROYAL SOCIETY OF MEDICINE (Epidemiology Section) (Annual General Meeting), at 8 —Dr P Stocks Infectiousness and Immunity in Regard to Chickenpox, Whooping Cough Diphtheria Scarlet Fever and Measles

ROYAL INSTITUTION OF GREAT BRITAIN at 9 —R S Whipple Some Scientific Instrument Makers of the 18th Century

SATURDAY, MAY 24

LINNEAN SOCIETY OF LONDON at 5 —Anniversary Meeting

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section) (at Leamington Spa)

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Edinburgh and East of Scotland and Glasgow Sections of Society of Chemical Industry) (at Edinburgh) (continued from May 23)

MONDAY, MAY 26

ROYAL SOCIETY, EDINBURGH, at 4 30 —Prof Niels Bohr Philosophical Aspects of Atomic Theory (Address and Presentation of the James Scott Prize)

VICTORIA INSTITUTE (at Central Buildings Westminster) at 4 30 —I Cohen The Jews under the Palestine Mandate

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8 —C L Woolley Recent Excavations at Ur

SOCIETY OF GLASS TECHNOLOGY (jointly with Deutsche Glastechnische Gesellschaft) (*May 26 to June 3*)

TUESDAY, MAY 27

ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5 —Annual General Meeting

INSTITUTE OF PHYSICS (at Institution of Electrical Engineers), at 5 30 — Dr W H Eccles The Influence of Physical Research on the Development of Wireless (Presidential Address)

QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street W 1), at 7 30 — Pond Life Exhibition

ROYAL ANTHROPOLOGICAL INSTITUTE at 8 30 —W P Rowe Art and Anthropology

WEDNESDAY, MAY 28

ROYAL SOCIETY OF MEDICINE (Comparative Medicine Section), at 5 — Annual General Meeting

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5 15

GEOLOGICAL SOCIETY OF LONDON, at 5 30

ROYAL SOCIETY OF ARTS, at 8 —H Barnard The Father of English Pottery — Josiah Wedgwood, F R S, Potter, Inventor, and Man of Science

THURSDAY, MAY 29

ROYAL SOCIETY, at 4 30 —Prof R Robinson The Molecular Structure of Strychnine and Brucine (Bakerian Lecture)

FRIDAY, MAY 30

ROYAL SOCIETY OF MEDICINE (Disease in Children Section), at 5 — Annual General Meeting

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts) at 6 30 —H R Ricardo The Development and Progress of Aircraft Engines

ROYAL SANITARY INSTITUTE (in Public Halls Blackburn) at 7 —Dr J J Buchan and others Discussion on The Re organisation of Poor Law Hospitals under the Local Government Act

GEOLOGISTS' ASSOCIATION (at University College) at 7 30 —S Hall A Study of the Coastal Geology between Marazion and Porthleven, Cornwall (Lecture) —Dr W G Shannon and L G Annis The Igneous intrusions of the Stoke Fleming Area South Devon

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Sir H C Harold Carpenter The Metal Crystal

SATURDAY, MAY 31

ROYAL SANITARY INSTITUTE (in Public Halls Blackburn) at 10 45 A M — Dr V T Thierens and others Discussion on The Need for Further Legal Powers with Respect to Ice Cream —H W Webb and others Discussion on The Provision and Maintenance of Dustbins—Private or Municipal

PUBLIC LECTURES

MONDAY MAY 26

LONDON SCHOOL OF ECONOMICS at 6 —Prof C Burt The Measurement of Mental Capacities (Succeeding Lectures on June 2 and 16)

TUESDAY MAY 27

SIR JOHN CASS TECHNICAL INSTITUTE at 7 —G Patchin Micro Examination of Engineering Metals and Alloys (Armourers and Brasiers Company Lectures) (Succeeding Lectures on June 3 and 10)

WEDNESDAY MAY 28

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE at 5 30 —Lt Col G E F Stammers Lecture and Demonstration on Tropical Hygiene (Succeeding Lectures and Demonstrations on May 29 30 June 2 3 4 5 and 6)

THURSDAY, MAY 29

CHELSEA PHYSIC GARDEN (Swan Walk Chelsea), at [illegible] —Dr A W Hill Cabbages and Kings (Chadwick Lecture)

INSTITUTE OF PATHOLOGY AND RESEARCH ST MARY'S HOSPITAL PADDINGTON, at 5 —Sir Thomas Lewis Reactions of the Skin to Cold

FRIDAY, MAY 30

UNIVERSITY COLLEGE at 5 30 —Prof G H Parker The Secretory Action of the Nervous System

CONGRESSES

MAY 26 TO 28

CONGRESS OF LEGAL MEDICINE (at Paris)

MAY 28 TO JUNE 1

GERMAN BUNSEN SOCIETY (Deutsche Bunsen Gesellschaft) (at Heidelberg) —Principal Subject for Discussion Spectroscopy and the Structure of Molecules

MAY 28 29 30, and 31

SOUTH EASTERN UNION OF SCIENTIFIC SOCIETIES (at Portsmouth)

Wednesday, May 28, at 8 P M (at Municipal College) —O G S Crawford What is Archæology ? (Presidential Address)

Thursday, May 29, at 11 A M —Alderman W E St. Lawrence Finny The Crusades and Pilgrimages

At 12 noon —Prof L S Palmer Some Correlations between the pre History of Hampshire and Africa

At 11 A M —Lt Col A H Wolley Dod: The Experiences of a Field Botanist

At 11 45 A M —Miss C M Gibson Paper

At 12 30 —Sir M Abbot-Anderson Resolution on the Preservation of Wild Flowers

Friday May 30 at 10 A M —H Dewey Cornish Geology and Scenery, with a Few Remarks on the Isle of Wight by Way of Comparison

At 11 A M —Lt Col J H Cooke Origin of Scenery in the Portsmouth District Geologically Considered

At 12 noon —Prof L S Palmer Recent Geology of the Portsmouth District

At 10 A M —J F Marshall The Organisation of Mosquito Control Work

At 11 A M —Miss G F Selwood Observations on Fauna Changes in a Bog at Bembridge, I W

At 8 P M —L B Benny Progress in Astronomy

Saturday, May 31, at 10 A M —G E Hutchings Some Applications of Regional Survey in Education.

At 10 45 A M —A Farquharson A Regional Survey of Chichester

At 11 30 A M —D H Thomson Springs, Streams, and Wells in the Portsmouth District

SATURDAY, MAY 31, 1930

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The Position of Fundamental Research

THE current report of the Medical Research Council directs attention to the present dearth of men able and willing to devote themselves to clinical research in experimental medicine In spite of the success which has attended the appointment in 1916 of Sir Thomas Lewis to organise work in clinical medicine—an experimental appointment which it may be noted in passing has been responsible for an output of valuable work on the scientific study of the heart and blood vascular system, its disorders and their treatment which has constituted the main stream of international progress in these subjects—it has been very difficult to find suitable men for appointment to the necessary assistantships This shortage of recruits of high attainments for scientific research work retards seriously the general progress of medical research Immediate opportunities for research in the hospitals are being wasted while the present system yields no proper supply of men qualified to undertake research elsewhere in the modern conditions required for scientific progress

A similar situation has been reported from France, and in post War Europe generally there has been a very marked shortage of candidates for careers of pure and experimental science, as compared with careers in applied science Progress in applied science depends upon fundamental scientific experimental investigation, and the concern of the Association of British Chemical Manufacturers in regard to the chair of organic chemistry at University College, London, is primarily due to realisation of this fact The awkward situation has revealed the unfortunate fact that not even a handsome salary has been able to attract a really first class organic chemist of the younger generation

Replacement of a chair of organic chemistry by one of physical chemistry may have grave consequences for the chemical industry of Great Britain and tend towards that same neglect of organic chemistry which fifty years ago was primarily responsible for our dependence on foreign countries for synthetic dyestuffs, drugs, etc Much more serious for mankind generally will be the consequences of neglecting the present international situation, and if no inquiry is made into the contributory causes of the shortage of recruits for professions of scientific research or attempt directed towards their removal

The International Committee on Intellectual Co operation, however, has been devoting some attention to this problem, and it was early realised that

the underlying causes are similar in most countries Prominent among these is the very different position offered to those who adopt a career of scientific research, whether in medicine, chemistry, or other branches of science, as compared with those offered in the field of applied science While the intellectual demands made upon the research worker may be, if anything, more severe than those made upon his colleagues in professional or industrial practice —he must have his problems in mind during most of his waking hours and be thoroughly versed in the scientific literature of all countries—his prospects are much inferior Brilliant success in research, even if measured by high international standards of value, will bring him no more than a moderate salary On the other hand, in medical practice, for example, merely moderate ability combined with good luck may make him a rich man, and even in Great Britain the opportunities for the chemist or physicist who adopts an industrial career or takes up consulting work to attain positions of high responsibility and remuneration are far greater than those of one who adopts a career of scientific research Even in industry there are many tendencies which act to remove the ablest investigators from the sphere of research, the normal avenue of advance or promotion being to administrative positions and away from laboratory work

Until there are a reasonable number of positions in the various branches of scientific research the occupation of which at middle age provides reasonable remuneration and adequate power of educating a family, the successful recruitment of young men of ability for experimental research cannot be maintained It must be realised, too, that young men of the type required will not be attracted if the promotion open to them is to positions which carry such burdens of teaching and administration as to debar them from the research work that it is their ambition to pursue In the words of the Balfour special research sub committee reporting to the last Imperial Conference "Special inducements offered at any early stage to tempt young men into a profession cannot make up for inherent deficiencies in the prospects which that profession can provide in salary, promotion, status, and opportunities "

To stress this point does not deny that the main driving force of research work of any high standard is scientific enthusiasm The real stimulus will always be primarily intellectual, but that stimulus cannot operate effectively if the investigator is too much occupied either with the struggle to secure and maintain a reasonable standard of living or with the discharge of administrative or tutorial duties Major F A Freeth alludes to this danger in his May Lecture to the Institute of Metals on "The Influence of Technique on Research", and he would be the first to admit that in the team work which industrial research demands under modern conditions, enthusiasm is as important a factor as a high standard of technique

It is to this latter factor that Major Freeth devotes most attention in the lecture to which reference has just been made One of the weakest spots in research in Great Britain to day, he asserts, is the totally disproportionate strength on the side of technique as against the numbers and efforts of people who are engaged in research, and the experimental facilities of the average university or research institution, industrial or not, are not nearly so effective as they could easily be This is true of other countries, notably of Austria, Czechoslovakia, Poland, Hungary, Russia, where remarkably fine experimental work has been carried out during the post War years under most discouraging conditions by a number of men of science whose work is only just receiving recognition The fundamental cause is the same everywhere—a shortage of men and a shortage of money, varying in acuteness from country to country There are, of course, a few brilliant exceptions, for example, Holland, where the foresight of Prof Kamerlingh Onnes led to the development, through the Instrument Makers' School at Leyden, of the technique and technicians required for his attack on the physics of low temperatures Again, in Great Britain, the wisdom and initiative of Imperial Chemical Industries, Ltd, have supplied the apparatus and equipment that have made possible the remarkably successful work in physical chemistry and in high pressure reactions at the Imperial College of Science and Technology and elsewhere

The future of fundamental research is, as Major Freeth suggests, dependent largely upon our ability to raise either from the community or from powerful individuals the money required for the development of adequate technique and resources It is dependent also on our ability to stimulate the maximum intellectual interest and enthusiasm of our experimental investigators It is dependent, too, upon our ability to reward the brilliant prosecution of laboratory work with recognition both in pay and in status which can compare with that which rewards similar abilty in administrative and other spheres of intellectual life The effort of the Medical Research Council to deal with this situation, not only by helping recruits of ability

during their preliminary period of training and probationary work, but also by increasing the number of stable positions in which the career of clinical research can be pursued with proper facilities and reasonable remuneration, for example, by increasing the number of clinical workers upon their staff as suitable candidates are available, is one that deserves support It means an immense contribution to the alleviation of human suffering, and renders possible the utilisation for the benefit of posterity of a wealth of experience which at present is being wasted

Medical research is, however, only one section of the field in which the shortage of recruits is so serious a problem While national efforts must play a great part in solving the problem, the efforts of such an international organisation as the Committee on Intellectual Co operation of the League of Nations may not only stimulate national effort but also may make important direct contributions Wisely directed, such a Committee can do much to bring the different national groups of scientific workers, or even the different classes of research workers, into closer touch with one another, to facilitate the exchange of technique, and by encouraging travel, remove some of the worst consequences of modern scientific specialisation It can assist materially in raising the status of the investigator in experimental science and in securing a more widespread appreciation of the importance of his work and its contribution to human progress—both fundamental factors in fostering that scientific enthusiasm and intellectual stimulus upon which fundamental research of the highest class so closely depends

The Doctrine of Atomic Valency

August Kekulé Von Richard Anschutz Band 1 *Leben und Wirken* Mit Titelbild, 119 Abbildungen im Text und auf 20 Tafeln und einem Faksimile Pp xxiii + 708 Band 2 *Abhandlungen, Berichte, Kritiken, Artikel, Reden* Mit 5 Abbildungen im Text und 3 Tafeln Pp xvi + 960 (Berlin Verlag Chemie, G m b H , 1929) Preis M 120 , M 90 to Fellows of the German Chemical Society, if ordered directly from the publisher Weight about 7 lb 10 oz

"IT was set down many years past and was the sense of my conceptions at that time, not an immutable law unto my advancing judgment at all times , and therefore there might be many things therein plausible unto my passed apprehension which are not agreeable unto my present self There are many things delivered rhetorically, many expressions therein merely topical and as they best illustrate my intention , and therefore also there are many things to be taken in a soft and flexible sense and not to be called unto the rigid test of reason Lastly, all that is contained therein is in submission unto maturer discernments "—Sir Thomas Browne—Preface to ' Religio Medici "

Such doctrine may well be applied to our ' Religio Chemici ", particularly in dealing with a work such as that under notice In terms which can only be spoken of as pathetic, Prof Anschutz presents these two massive volumes to us as the completion of a task piously undertaken thirty three years ago, at the time of Kekulé's death, at the request of Emil Fischer, on behalf of the German Chemical Society It is impossible to overrate the value of the service our German colleague renders to his cloth in this his centenary gift Few know how great are the difficulties of writing real biography, the heart searchings attending the desire to compose a truthful picture, with balanced judgment From my own experience, I can form a fair estimate at what great cost of effort this likeness has been limned

Were there not so much barium in it, the first volume might be said to be worth its weight in gold The price charged, however, is beyond that penniless, pensionless English professors can afford to pay Why German scientific books are now so very expensive is a mystery—and a misfortune Libraries even are ceasing to purchase them

No self respecting chemical librarian should be without the books No chemist's biography yet written is of greater interest and importance it is, however, necessarily very difficult reading , few of the younger generation will be able to grasp the story in its entirety , so many and such diverse and dominant characters cross the stage and so much is told of disputes, which, if not due to misunderstanding, were at least due to a failure of those concerned to understand one another and be in sympathy or, indeed, show any real sense of humour We are in face of a play of commanding and rather irascible intellects, very difficult to interpret without considerable experience of life and personal knowledge of the men concerned, as well as of the times in which they moved—the more so, as the plot is laid not in one country but in three, England, France and Germany, leading characters being drawn from all three Having known most of the chief actors, I probably am in a better position than most to carry a thread through the labyrinth to its core to give some weight to the many personal equations involved in the story

Kekulé was a born collector Prof Anschütz

has been fortunate in having a large amount of documentary evidence at his disposal in the correspondence he preserved, also the help of many who knew the man Not a few hitherto doubtful points in chemical history are cleared up in the course of the recital The task of writing such a memoir must have been a heavy one, though clearly a labour of love We cannot be too grateful for the work, having long awaited its appearance, our patience is amply rewarded in most respects, not in all

The account is written throughout upon the serious side we scarcely learn enough of the man apart from his work, in his leisure and social moments He was born in 1829 and died in 1896 His origin, his upbringing, his character, his unceasing activity as a laboratory and literary worker are clearly displayed, the problems he dealt with a'ɔ all stated yet no sufficiently vivid picture is drawn of the man himself—otherwise than incidentally—enabling those who did not know him quite to understand his magic personality We do not hear enough of his entourage—of the wild pranks of some—of which I have heard Dewar relate The book is one which a general historian could scarcely read—even a Lytton Strachey could make little of it yet the story will be found full of fascination to the expert Fortunately, a number of photographs, taken at different periods of Kekulé's life, are reproduced, which are of great psychological value One charm of the work is the large number of photographic reproductions it contains to them it owes its weight Nearly everyone referred to is pictured

The leading theme is the part played by Kekulé in establishing the basic doctrine of chemical structure—that of atomic valency (1857) The subject is treated with a rather heavy hand Anschutz, in fact, claims (as indeed did the subject of the memoir himself, originally, I have no doubt in perfect sincerity—young people who 'hear voices' are prone to think that they come to them alone) that Kekulé was essentially the first to recognise and formulate its rules not merely that he developed the doctrine specially in relation to carbon, the view that is generally held Frankland is simply denied all credit Williamson and Odling are favourably mentioned and Gerhardt is seen standing *in loco parentis* in the dim background Kekulé, with Williamson and Odling, were, we know, lineal descendants of the Laurent Gerhardt school Frankland and Kolbe were of another stock, dating back to the Stockholm stable, the main seat of chemical philosophy in the early post-Lavoisier period Some day, probably, when the Arrhenic ion is no longer our ikon, we shall return more to the worship of Berzelius—if meanwhile we do not lose our power to interpret the language of his period, as we have that of the phlogistic period, of which we have warning already in Kekulé's difficulty in understanding Kolbe Prof Anschutz has much to say of Kolbe's *Grobheit* towards Kekulé, which he bitterly resents, without attempting to explain it Kolbe was greatly affected by the 1870 war, which made him a most violent nationalist and '*Franzosen fresser*' I suppose I am one of the very few alive who knew him I can never think of him in terms other than those of admiration and affection In writing (1927) a review of the period for the *Chemiker Zeitung* on the occasion of its jubilee, I took occasion to speak out on his behalf and recall the greatness of his service I have since heard from German colleagues, that they were surprised by my advocacy Kolbe is chiefly known to day by his attacks on Kekulé and van 't Hoff the fundamental importance of his work is overlooked Some day when—as Sir Thomas Browne might urge us to do—we omit the 'improperations and terms of scurrility' which he launched at Kekulé, he may come to be regarded as the parent of the modern system of resolved structural formulæ we here have to thank him for having made Frankland, whose senior he was, what he became When I left him early in 1870, he was already peculiar he afterwards, in his last years, so fixed his mind upon certain grievances as to be little short of a monomaniac

No four men could have been more different than were Frankland, Kolbe, Hofmann and Kekulé Hofmann was the complete courtier and diplomatist, a man of the most engaging and sympathetic manners, gifted with a marvellous enthusiasm for his subject Kekulé was a born aristocrat in manner An intellectual of a high order, many sided in his interests, he was too critical and cynical to be a leader of men in the way that Hofmann was, though even superior to him as an orator, he attracted through his clear cut talent, his gift of precise speech and his great command of knowledge He had an astounding memory Frankland was a man of eminently simple, retiring nature, with a strong practical outlook, a demon worker but in no way eloquent Kolbe was equally simple, never a man of the world, a good lecturer and a far better writer but not an orator the best chemist of them all. Hofmann and Kekulé were cosmopolitans, Frankland was ever the plain, high souled Lancashireman, Kolbe—just the dear old German, academic peda-

gogue of the highest class: there is no other way of describing him.

Nothing is more certain than that most of us only take in new ideas through experience—the want must be felt before it can be satisfied. Once assimilated, an idea is expelled or modified with great difficulty. It is this that makes scientific thought, the scientific habit of mind, so difficult of attainment. Kekulé at once fell a victim to Gerhardt's magic influence, when he met him in Paris. His belief in Gerhardt's system became strengthened, in London, through association with Williamson and Odling. He does not seem to have been intimate with Frankland. He appears to have been so satisfied of the superiority of Gerhardt's system, that he took little, if any, notice of Kolbe's work. I do not believe that he ever mastered the inner meaning of Kolbe's formulæ. Kolbe had little use for the Gerhardt formulæ, knowing that he had penetrated deeper than they carried him. I feel sure he resented the way in which he and Frankland were waved aside by Kekulé and probably, this was the subconscious, if not conscious, primary cause of the bitterness he displayed towards him, in later life. In addition, he was a linguistic purist and idealist and was greatly annoyed by Kekulé's at times flamboyant masterful style. As I have said elsewhere, Kolbe's doctrine was ever the Pauline "Alles prüfen"—Prove all things! He took exception, therefore, to what he thought to be Kekulé's dogmatic, if not arrogant, declarations. Intellectually, Kekulé probably was Kolbe's superior but not as a constructive worker; Frankland and Kolbe's synthesis of acetic acid (1846) is one of the most clear-cut achievements in the early history of the development of the doctrine of chemical structure. Kekulé seems never to have grasped its significance and the extent to which it put their work in advance of his.

In his Kekulé memorial lecture (1897), the late Prof. Japp, who was intimately associated with both Frankland and Kekulé, boldly took the valency infant in hand and divided it between the contending parties, assigning the body to Frankland and the head, at most, to Kekulé. His ultimate conclusion was that indicated by Kekulé himself, on the occasion of the great benzene festival in Berlin, Mar. 11, 1890, at which I was present as representative of our Chemical Society. As Kekulé then said, speaking of the contending parties, eventually, "both sides—he at the head of the one, Frankland of the other—saw that they had been striving towards the same goal, although by different routes. They exchanged experiences, each side profited by the experience of the other and with united forces they sailed onward."

This is a charitable and broad point of view to which, unfortunately, our German colleague has not lent himself. He takes no notice of Japp's argument, although fully aware of his lecture. He lays no weight upon Kekulé's considered confession. The chief cause of misunderstanding, we now see, was the uncertainty of atomic weights. The cloud was not dispelled until 1860, when Cannizzaro came forward at Carlsruhe and electrified chemists by proclaiming Avogadro's theorem as a precise physical means of establishing the constants of atomic mass. The congress was Kekulé's work: he had seen the need of a decision.

It is only when obituary notices are to be written, that the difficulty of securing any real picture of a man and his achievements becomes the stark, staring certainty it usually is. Then the lights are over painted and the shadows are usually left out. The *nil nisi* adage has done infinite injury. Later on, when the general historian sets to work, he finds himself without safe material to go upon—so history becomes a polite and perjured fiction. The recent marvellous exhibition of Italian pictures at Burlington House has brought this difficulty to the fore—little is known of most of the painters to give the full and desired clue to their painting. We shall never arrive at a real appreciation of the psychology of the scientific worker until we devise some system of periodically reviewing men's progress; better, perhaps, a scheme whereby the keeping of a real diary, including critical comments by friends, relations and others, be made compulsory. In such a way only will truthful history be written in future. Kekulé set an example in keeping his letters. Some of us who are grown up to old age must bitterly repent that we have not followed Mr. Pepys.

To arrive at a general understanding upon special issues must often be impossible—our minds cannot all grasp all that is involved, even if we grasp the issue at all. It is not that "bowsprit gets mixed with rudder sometimes" but that fiddle cannot play the part of flute. Our discussions are often absurd, for this reason: two minds are not always, indeed seldom, open to the same reason.

I would urge, with Sir Thomas Browne, that "it is the method of charity to suffer without reaction"—that it were time to bury the Kekulé-Kolbe hatchet and give all the workers their due meed of recognition, without reference to any incidental reflections. German chemistry has a great heritage in the two men. Kolbe was especially great as a practical executant guided by acute

theoretical conceptions, to him we owe salicylic acid as a manufactured product Kekulé we can claim as a great intellectual master of his subject—donor of the carbon tetrahedron as well as of the immortal benzene hexagon, both veritable and imperishable foundation stones of the theoretical structure of organic science

His biographer is quite outspoken as to some of the social events in Kekulé's career Marrying in June 1862, when thirty three years old, he lost his wife, within a year, in child birth He thereafter devoted himself to the upbringing of his son, only marrying again in 1876 The choice seems to have been a very unfortunate one, his wife being not only of weak physical stock but, in temperament and outlook, incompatible with a man of his intellectual disposition and habits Three children were born of the marriage but all these died in middle age of tubercular disease The comparative scientific infertility of his later years is easily understood when these distressing facts are known

Prof Anschütz has established a Kekulé museum in the Polytechnic at Darmstadt He tells us, that among its treasures is a complete set of notes of Liebig s lectures taken down by Kekulé, also a similar set by Dr Holzmann of Kekulé's Ghent course These must be priceless historical documents Is it asking too much that they should be reprinted as an Ostwald "Klassiker"?

In fine, we cannot thank our German colleague too heartily for his full and reasoned statement of the case Kekulé v Frankland, Odling and Kolbe being cited as co respondents in support of one or the other side In the interests of historic truth, we have now to submit this to a full Court of Appeal It must be dealt with as a Chancery case of world wide import and the meaning of every word and sentence considered, as well as the conditions of the times to which the issues raised relate The brief is a heavy one and the permission of the Court may well be asked for a postponement of the trial until all the necessary interrogatories have been administered and the evidence marshalled afresh We can in no way admit that a case is established we feel sure that eventually honours will be declared divided The statement is none the less interesting, as a passage in the history of our science Prof Anschutz, all will agree, has laid chemists under a debt beyond repayment, by providing them with an adequate memoir of a great warrior, who will always stand before us carrying as shield the incomparable Hexagon to which we may well add the magic tetrahedron as a quartering

HENRY E ARMSTRONG

World Power and the Power of Man

The Time Journey of Dr Barton an Engineering and Sociological Forecast based on Present Possibilities Edited by John Hodgson Pp viii + 89 + 16 plates (Eggington, Beds John Hodgson, 1929) 3*s* 10*d*

IT has become a platitude to say that modern science has provided man with unlimited power over Nature, but if Nature includes man, the platitude is false Slums, unemployment, starvation, and wars bear ample witness to this We may be able to devise the most cunning calculating machines, we may conquer the sea, the air, and the road at incredible speeds, we may flash messages around the globe, probe the atom, and span the outermost confines of space, we may multiply our productivity a thousand fold, but we have not yet conquered the simple problem of distributing the produce of the earth among its inhabitants Has the world population multiplied so enormously that even with the immensely increased productivity that science has provided, we inhabitants of the globe cannot supply our needs, or are we merely still unscientific fools who have not yet considered the first step towards a rational view of world supply and distribution? The fact is, of course, that we are still so steeped in historical and racial prejudices that we have not yet a glimmering of the historical and racial prejudices we have to overthrow before we can examine this question with scientific detachment

Even with our comparatively new found control over material things we are little more than rampaging savages, tearing minerals from the bowels of the earth and levelling forests in wasteful profligacy, to convert them into machinery and power, without a thought of the morrow We have scarcely given a serious thought towards the control and utilisation of world power

Mr J L Hodgson, the well known engineer, in "The Time Journey of Dr Barton", makes a brave attempt to face these and similar issues The author is clearly not one to be swayed by local prejudices, or to be turned from a grand idea by a mere question of national or international complications If it is necessary, in the interests of world power production, to dam up the Straits of Gibraltar with 500,000 million tons of rubble, clay, masonry, concrete, and rock blasted from the Jebala mountains in Morocco fifty miles away, then dammed up it must be The work of construction may take more than a hundred years, and another six hundred years may be required

to lower the sea level sufficiently by evaporation, but what of that? The great power stations at Gibraltar and Port Said would produce 250 million horse power each, evaporation from the whole basin would provide 600 million horse power, or about three times the world's present estimated available water horse power, while some 60,000 square miles of fertile land would be reclaimed

In order to provide a survey of these problems in sufficient perspective, the author borrows Mr H G Wells's device of a "Time Machine", and projecting Dr Barton 2000 years forward, flies him over the surface of the earth as it is transformed and organised according to the ideas of Mr Hodgson By this means he is enabled to pass in critical review the wastefulness of the present day, and to contrast it with the world as it might be under a rational system of organisation It is an old device, an old dream, but the author with his individual point of view has many penetrating things to say His criticisms are not all new, of course, they have been the concern of socially conscious people for years, but he has succeeded in producing a thought provoking book, and a number of constructive—if grandiose—schemes The idea of straightening the great rivers for power production, altering their courses to transform and deserts into luxuriant and fertile lands, of boring miles into the earth for heat power, and of damming up the Mediterranean Sea, are enchanting dreams for an engineer Meanwhile, we cannot make up our minds on the question of a mere Channel Tunnel

The author is not content, however, with a mere exposition of the power of power He has much to say of our human wastage, useless child bearing and infant mortality, debility from preventable diseases, indulgence in soporific drugs, wars, competition and obstruction in civil life, faulty planning of necessary world routine work, our stupid and obscure money system, restrictions due to language differences, all the criticisms, in fact, that inspire isolated small groups to enthusiastic but impotent reform To most of these he has something new and refreshing to add

Mr Hodgson's attempt to read a lesson in world potentiality, while it is intensely illuminating, does not face the real issue There have not been lacking religious, social, and now scientific enthusiasts to point to a visionary future as a possible present, but inherent in its attainment is always the difficulty of reaching to it As well ask a paralysed thirsty man to reach out for water If we were merely inhabitants of the earth, we might corporately and intelligently avail ourselves, in the most scientific manner, of the world's enormous possibilities, but we are not such idealised beings We are creatures of prejudice, we prefer Oxford to Cambridge, England to Scotland, Britain to France, whites to blacks We have acquired special rights here, and inherited prestige there, which we must not lose, in groups we are morally and racially superior to this one and that, and we have Imperial, national, civic, or parochial 'principles' at stake To the student who, like Mr Hodgson, frames his problem on a world scale, there is no measure for these trivialities His picture is grandiose and alluring But to him who has to handle the problem on a national or local scale, the picture is sordid and cramped We become paralysed spectators We are hungry, but with all the will in the world we cannot eat of the alluring fruits dangled before us H LEVY

North American Dragon-flies

A Handbook of the Dragonflies of North America By Prof James G Needham and Hortense Butler Heywood assisted by Specialists in certain Groups Pp viii + 378 (Springfield, Ill, and Baltimore, Md Charles C Thomas, London Baillière, Tindall and Cox, 1929) 31s 6d net

NEARLY seventy years have elapsed since the last comprehensive publication on North American dragon flies appeared and the number of known species has about doubled itself in the mean time The present volume will be welcomed as one which fills a much needed requirement, since it is not merely a guide to the species found over that continent, but is also a general introduction to the order as a whole Unlike its predecessor, it is not a severely technical work, and it is primarily designed for collectors of these insects and for students of their natural history

Part 1 of the book is introductory and describes the essential facts of the structure and biology of dragon-flies, together with methods of dealing with the rearing of the nymphs, and the collecting of the adult insects The greater part of the text is comprised in Part 2, which is devoted to an account of every species of these insects found in North America Free uses are made of synoptic keys to the families, genera, and species, the nymphal stages being treated similarly wherever possible Each species is further described in detail, its distribution is indicated and notes on its habits, times of appearance, or other special features, are added in a large number of cases Some

of the keys, however, appear to be exceptionally short and brief, and it seems open to doubt whether they are really sufficient for the purpose intended in every case Also, the illustrations, although numerous, are of very mixed character—the venational figures leave little to be desired, but those which portray the genital appendages are somewhat crude and deficient in detail—in some cases it would appear difficult in practice to separate one species from another from the illustrations

Taken as a whole, the book is an excellent one for the needs it is intended to supply, and it is no small achievement to have dealt with a fauna comprising 75 genera and 360 species and describe every one of the latter Over so wide an area as the North American continent there must be many more species yet to be discovered the geographical ranges of the known species are, as yet, but imperfectly mapped, often only one sex has so far been described, but for many species the nymphs still remain unknown To these desiderata may be added the need for life history studies, since they have only been followed completely and accurately in very few dragon flies It is, therefore, within the capacity of every user of this book to contribute something new to the subject, however small or apparently insignificant the facts may be With the present guide at their command, those who observe and collect American dragon flies will acquire renewed stimulus, and their gratitude is due to the authors of this book, and to the specialists who assisted in its production A D I

Our Bookshelf

Grosse Naturforscher eine Geschichte der Naturforschung in Lebensbeschreibung Von Philipp Lenard Pp 324 + 16 Tafeln (München J F Lehmanns Verlag, 1929) 12 gold marks

In his account of the personal history and life work of great men of science, the author has attempted the ambitious task of selecting the most outstanding achievements in scientific thought from the days of Pythagoras to modern times Naturally enough, he has excluded from his survey all living persons, and for this reason he has arbitrarily chosen the end of the War as his time limit The reader is bound to marvel at the thoroughness and patience with which the original records have been searched in the earnest desire to avoid the temptation of following too closely the many standard historical works on the subject In fact, the author claims that credit has sometimes been erroneously given for new lines of thought to those who have merely developed and expanded what was no longer new but had with the lapse of time been overlooked For example, the discovery of the rare gases of the atmosphere, to which merely a passing reference is made, is regarded as the natural development of an early experiment by Cavendish, and the actual discoverer of radium is not named

The book opens with Pythagoras, founder of a great school of morals, to whom is attributed the credit of pointing out the importance of quantitative measurement The daily rotation of the earth, for the recognition of which Galileo had to fight two thousand years later, was also taught Euclid, Archimedes, and Hipparchus, the astronomer, whose accurate observations were chiefly made known through the writings of Ptolemy, complete the list of pioneers of the pre Christian era Then follows a dead period of more than fifteen centuries, in which none of equal eminence is to be found The new era opens with Leonardo da Vinci, the famous painter, who left behind a valuable mass of notes, which reveal his extraordinary genius in no uncertain manner Then follows a brilliant succession of astronomers, mathematicians, physicists, and chemists, among whom we find the names of many eminent Englishmen— Boyle, Newton, Black, Watt, Priestley, Cavendish, Dalton, Davy, Faraday, Kelvin, Maxwell, Crookes, and others Biological science is represented by Darwin, to whom several pages are devoted, and by Mendel

A Course in Physics for Medical and Dental Students By Richard Ablett (Oxford Medical Publications) Pp xviii + 249 (London Oxford University Press, 1930) 8s 6d net

THERE was reviewed in these columns last year a book by Prof Russ on physics for medical students In that book the author stated his aim to be to concentrate on parts of physics of most direct application in medicine This meant cutting down the sections on sound and magnetism to a minimum Mr Ablett in his book, with apparently the same object in view, has omitted these two subjects altogether As he says, he feels that sufficient ground is already covered in these subjects at school and any further work in the subjects would not be commensurate with the value of the applications met with later, at least in comparison with those in other branches of physics

These two aims at departure from the stereotyped form in which physics is presented to the medical student of to-day indicate a genuine desire on the part of at least two teachers to do more for the medical student with physics than has been attempted in the past To the reviewer it seems that Mr Ablett has succeeded extraordinarily well in the task he has set himself In practically every section of the book some space is given to the direct application in medicine of the physical principles enunciated This makes excellent reading, and the student cannot fail to see the significance of the subject in the bigger one of medicine that he is tackling

If, however, these attempts are to be anything more than attempts, some recognition should be given to them, and the only way in which authority can do this is to agree upon a recasting of the syllabus for the pre medical examinations For the furtherance of his plan Mr Ablett is placed at an

advantage in that he is teaching his physics to students whom his department will be examining later on, but it is a very different matter to get these different aspects of physics a definite place in the curriculum of medical schools all over the country The first thing, of course, is to get a responsible body of people to express an opinion as to whether it is desirable, and if it is, then immediate steps should be taken to give effect to responsible opinion

Traité de biocolloïdologie Par W Kopaczewski Tome 1 *Pratique des colloides* Deuxième édition entièrement remaniée et mise à jour Fascicule 1 *Propriétés mécaniques des colloides* Pp xviii + 166 + iv (Paris Gauthier Villars et Cie, 1930) 40 francs

DURING the past eight years the author has produced eight volumes dealing with various branches of colloid science, with catalysis, hydrogen ions, and mineral waters The present treatise appeared first in 1922, but is now being expanded to a series of five volumes, dealing with colloid technique, bio colloids, conditions of equilibrium of bio colloids, the colloidal state and biology, and the colloidal state and medicine, respectively The first section of the first volume, which has now been issued as a separate part, under the general heading of mechanical properties of colloids, covers the preparation and properties of pure water, the preparation of hydrosols and hydrogels, determination of density of liquids, determination of micellar dimensions, diffusion, ultra filtration, dialysis, and the swelling of gels

In the preface to the new edition, the author himself describes the success that has attended his work, explains why his book has been so successful, points out that no similar book exists in scientific literature, and issues a warning as to the treatment that will be meted out to those who quote his work without acknowledging the source from which they have borrowed their material Since the first volume, when complete, will include about 600 pages and is to be followed by four others, it is clear that the literature of 'biocolloidology', like the gels described in the last chapter of the present issue, is likely to undergo considerable swelling in the near future

A Simplified Presentation of Einstein's Unified Field Equations By Prof Tullio Levi Cività Authorized translation by Dr John Dougall Pp 22 (London, Glasgow and Bombay Blackie and Son, Ltd, 1929) 2s net

AT the beginning of 1929, Einstein published his unified field theory of gravitation and electromagnetism, based on the concept of parallelism at a distance with respect to four orthogonal vectors of reference Levi-Cività discards this concept and uses Ricci's coefficients of rotation This is termed a simplified presentation of Einstein's theory, but it really differs from it in one important respect It is perhaps more elegant than Einstein's work, and obtains Maxwell's electromagnetic equations and the gravitational equations of the older relativity theory exactly, whereas Einstein now obtains these only as first order approximations The fact that Einstein's new equations, in their exact form, contain both gravitational and electrical terms in a way that defies separation, however inconvenient it may be mathematically, is yet the most attractive feature from the physical point of view, as it may possibly lead to the discovery of new experimental facts on the interaction of gravitation and electricity Up to the present, in spite of improvements in the mathematical presentation of Einstein's work, little progress has been made on the physical side, and the problem of incorporating the quantum theory with relativity remains still unsolved

H T H P

Differential Geometry of Three Dimensions By Prof C E Weatherburn Vol 2 Pp xii + 239 (Cambridge At the University Press, 1930) 12s 6d net

THE distinctive feature of Prof Weatherburn's treatment is the great use that is made of vector analysis At first sight a page full of terms such as *div*, *rot*, *grad*, and *dyadic* looks rather alarming, and the Clarendon type used for vectors stands out from the ordinary type used for scalars, producing a somewhat unattractive mixture, as if the printing had been done by an unskilled hand However, a careful study will show the advantage of vector methods They are very concise, and yet they emphasise the geometric considerations which are often obscured by the use of co ordinates

The book contains thirteen chapters, the majority based on Prof Weatherburn's own researches Chapters i and v deal with differential invariants, ii, iii, and viii with families of curves on a surface, iv and vi with families of surfaces, vii with dyadics, ix with Levi Cività's parallel displacements, x with projection and allied topics, xi and xii with deformation and flexion, xiii with congruences of curves There are twelve sets of examples, eleven diagrams (we could wish for more), and an index H T H P

The Annual Register a Review of Public Events at Home and Abroad for the Year 1929 Edited by Dr M Epstein Pp xiv + 326 + 164 (London, New York and Toronto Longmans, Green and Co, Ltd, 1930) 30s net

THIS valuable work again contrives to cover a survey of the world's history within the compass of a few hundred pages Its hundred and seventy-first issue speaks for its usefulness Little change is made in the customary arrangements Part I, which constitutes more than half the volume, is devoted to English, Imperial, and foreign history, for this year the sections on India and the Dominions are grouped together Mandated territories are included in the foreign section but the colonies seem to be omitted Part II begins with a chronicle of outstanding events followed by reviews of literature, science, art, finance, and law, and a number of biographies The scientific section has ten pages of an admirable summary of work in the biological and physical sciences Appendices give the text of certain treaties of the year

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

The Age of *Australopithecus*

THE little fossil ape skull that was found at Taungs five years ago is, in the opinion of many, the most important fossil ever discovered It is manifestly the remains of an anthropoid ape somewhat allied to the chimpanzee and of about the same size But it differs from both it and the gorilla in a large number of characters, and in almost all these characters it resembles man It thus seems highly probable that it is very near to the ape from which man sprang, and possibly a representative of the very genus One difficulty has been our ignorance of the age of the cave deposit The bone breccia found in most caves has proved to be of Pleistocene age and if the Taungs cave is also of this period, then *Australopithecus* would be too recent to be a possible human ancestor, as man is known to have existed in the Pliocene

Dr du Toit and I have independently suggested that the deposit is quite as likely to be Pliocene as Pleistocene but we had very little evidence of the age A couple of months ago Prof Dart kindly allowed me to have for examination a few pieces of bone breccia that had been found in association with the ape, and an examination of this material has resulted in such important new light that a preliminary announcement seems called for

It has been known for some years that remains of an extinct baboon occur in considerable numbers in the deposit, and this has been named by Haughton *Papio Africanus* It is a primitive baboon not very closely allied to any living forms

There are also large numbers of skulls and bones of a Dassie This on examination also proves to be an extinct form, which I am calling *Procavia (Prohyrax) antiqua* It is fairly similar in size to the common Cape hyrax, but the teeth are much more brachyodont

A more startling discovery has been a giant rodent mole rather larger than *Bathyergus*, but more nearly allied to *Georhychus* It has large flat permanent growing molars I am naming it after Prof Dart, *Gypsorhychus darti*

Then we have remains of a small spring hare which is quite a distinct species from the living one This is being called *Pedetes gracilis*

There are portions of the skulls of at least three antelopes One too imperfect for identification is about the size of a reed buck The other two which can be determined are both extinct forms The larger of these two bucks is roughly about the size of an oribi It has a very large antorbital depression, and the orbit is placed farther back than in any living buck of the subfamily Neotraginæ to which it clearly belongs I am calling it *Palæotragiscus longiceps*

The smaller of the two identifiable bucks is allied to the blue buck, but much smaller, and the smallest member of the genus It is being called *Cephalophus parvus*

There are fragmentary remains of a number of other small mammals, and of birds, tortoises, and lizards, beside numerous carapaces and limbs of a fresh water crab (*Potamon* sp)

All the mammals sufficiently preserved to be identifiable prove to belong to extinct species, and the baboon and hyrax are primitive types

A deposit in south west Africa, which is believed by Stromer to be of Miocene age, has yielded remains of a Hyracoid, a spring hare, and a Bathyergid But none of these south west African forms is closely allied to the Taungs animals

As no forms exactly similar to those of this breccia are known from elsewhere, we cannot, of course, determine the age with certainty As, however, all the mammals are extinct forms, the evidence is strongly in favour of the deposit being Pliocene, and I think quite likely it will prove to be Lower Pliocene

R BROOM

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Grahamstown, South Africa,
April 9

Comparison of the Ultracentrifuge Method for Molecular Weight Determination with the Classical Methods *

UP to the present there has been scant possibility for a direct comparison between the ordinary methods for the determination of molecular weights of substances in solution and the recently developed ultracentrifuge method In fact, Adair's refined osmotic pressure measurements on hæmoglobin,[1] giving a value (66,000) that compares favourably with the ultracentrifuge value of 68 000,[2] provided the only independent data It was therefore thought desirable to attempt a comparison on a substance of sufficiently low molecular weight to give fairly trustworthy results with the ordinary methods of boiling point elevation or freezing point lowering

The ultracentrifuge method of determining molecular weights depends in principle upon the analysis of the light absorption of the radial concentration gradient in the solution subjected to a strong centrifugal force In order to obtain satisfactory results for molecules of the order of 1000 in weight, we therefore chose two substances possessing a high light absorption and a high density sodium eosinate and sodium erythrosinate With a centrifugal force of 9000 times gravity the sedimentation equilibria in 0 5 per cent salt free solutions corresponded to molecular weights of 403 and 977 respectively, the boiling point method gave 530 and 601 for the first compound and 622 and 636 for the second

These centrifuge values are only apparent owing to the electrical effect arising from the partial separation of the large dye ions from the small sodium ions, similarly, the boiling point values give only an apparent molecular weight on account of the large ionisation of the sodium dye salts When enough sodium chloride was added to eliminate the electrical potential arising from the partial separation of ions in the centrifuge, both dyes were found to consist in solution of double molecules with two dissociated sodium ions The other two sodium ions are perhaps rendered osmotically inactive by the close proximity of the complex dye group— that is, the Hammersten effect The sodium eosinate consists wholly of double molecules—the value found was 1343, as compared with 1384 for the molecular weight of $(Na_2 \text{ eosinate})_2$— but the sodium erythrosinate has, in addition to double molecules, a small amount of more highly associated material and perhaps some fragments of molecules in solution as well It is not likely that the concentration of sodium chloride used was sufficient to produce any 'salting out' effect, but this point must be studied in more detail

The successful application of the ultracentrifuge method to the study of these dyes enables us to attack the special problems—degree of uniformity, purity,

* Contribution No 33 from the Experimental Station of E I du Pont de Nemours and Company

degree of ionisation, and the like—of the substances of molecular weight of the order of 1000 from two converging angles first, the ordinary methods for relatively simple molecules, and second, the centrifuge method for more complex molecules

In the ordinary methods, the solution must be absolutely free of foreign ions of low molecular weight and the ionisation must be considered in calculating the true molecular weight of the substance in solution On the other hand, it is evident from the results obtained that the centrifuge gives the molecular or ionic weight directly even though foreign ions or impurities are present, that is, if enough electrolyte is added to repress the electrical potential set up by the partial separation of the ions in the centrifuge

A detailed account of this work will be published elsewhere J B NICHOLS

Du Pont Experimental Station,
Wilmington, Delaware,
U S A , Mar 29

[1] Adair *Proc Cambridge Phil Soc* Biological Sciences, 1, 75 1924 Sorensen's osmotic pressure value of 34 000 for the molecular weight of egg albumin agrees well with the ultracentrifuge value However his interpretation of his data has lately been questioned by Adair and also by Marrack and Hewitt who consider 43 000 to be the correct value

[2] Svedberg and Fåhraeus *J Am Chem Soc* 48 130 1926 Svedberg and Nichols *J Am Chem Soc* 49 2920 1927

Stability in Soap Films

THE great increase in recent years of knowledge of the specific properties of surface films has naturally made it easier to understand more of the recorded behaviour and stability of Dewar's long lived soap bubbles and films, but among the questions that may still be considered uncertain that of the possible stratification is not the least interesting Recently it has been suggested that stratification in soap films is an abnormal condition, partly because under a certain defined condition a sheet of permanently solid leaflets can be produced

Now it is certain first that the usual limpid grading of the several colour bands down to the universally sharp boundary of the 'black' film is a deception masking the real mechanism When a bubble develops under perfectly quiet conditions of temperature humidity, etc, the colours do not remain graded for long, but separate between numerous boundaries, usually visible to the unaided eye, and often quite as distinct as that defining the 'black' area Several of the Dewar colour photographs show this in part The fully developed appearance is very like stratus clouds at sunset Further, in early stages of development especially, the graded coloured film is invaded by numerous stars, often drawn out by movement into a comet like shape, and always well contrasted in colour from their surroundings, that their boundary tends to the circular shape is evidence of their definite separation from the surrounding film (Fig 1) Even in a film much too thick to show colour, similar behaviour can be detected at glancing incidence

This latter appearance can be induced in greater or less measure over the whole of a quiet bubble by very small departures in the direction of either alkalinity or acidity from the optimum value for the stable bubble This reaction is akin to the well known tumultuous or 'critical' development (but not extending to the black stage) and can be readily seen, for example, by momentarily removing the stopper from an ammonia reagent bottle near to a quietly graded bubble on a ring in the open air, It is reasonable also to suppose that this is a similar occurrence to the experiment of Lyons and Rideal in forming at will a bimolecular from a monomolecular acid film by small increase in alkalinity, and that it is in the same class as the observations recorded in the Dewar papers of the spontaneous change of second order into first order black in dilute 'Plateau' solutions, the deeper black appearing on the uniform greyer black as a slowly growing circle ringed with tiny silvery droplets from the aggregation of the disappearing layer It may be added that this has occurred in a quiet black film formed from ordinary concentrated Plateau solution which is approximately 2½ per cent sodium oleate in 25 per cent glycerin

Here, then, the Perrin and Wells stratifications become revealed as almost certainly pervading the whole film, which appears therefore to persist not merely because of the intrinsic cohesiveness of the several bi or poly molecular strata, but also by means of a powerful but labile attraction between their successive surfaces throughout the film these surfaces being so well ordered in some definite arrangement as to be mutually active The picture agrees with an extension of the McBain diagram with a more extended and more com

FIG 1 Normal thinning of soap films showing separation of various coloured spots

plete orientation beneath the surface layers, and it seems reasonable to suppose that cohesive layers, in whatever position they may be formed, would be as orderly as possible in the absence of disturbance and finally extend to complete lamination in films of reasonable thinness McBain's diagram shows partial bimolecular layers often reduced almost to monomolecular thickness by a sort of alternate lateral surface cohesion or mutual activity of the successive long chain molecules, and indeed such a mesh gives the impression of greater strength and stability than the more commonly depicted monomolecular sheet, unsymmetrical of course on its two faces, and supposedly only so maintained by the anchoring action of the carboxyl radicles presented over one face only

The extended stratified appearance is no doubt presented in large quiet bubbles rather than in flat films on rings of moderate dimensions, because the disturbances from the Gibbs' ring support are more remote in the former case The intensity of formation of the thicker coloured leaflets is not so great as that producing the black or thinner stages So much is evident from the description in the Dewar papers of various forms of black development—from the slow separation and coalescing of tiny black spots throughout a coloured film, to the cataclysmal aggregation of black masses from a thick scarcely coloured liquid sheet up through a whirling delta to the rapidly extending black area 'Spots' and 'black masses' are, however, the very antithesis of what must, on the dimensions of the film itself, appear relatively as deep hollows and abysmal canyons, the black stream, as

it forces its way through, piles up the thick film on each side in a manner almost as miraculous as the passage of the Israelites across the Red Sea ! A very large lowering of surface energy in the production of the black state would explain this

Doubtless, then, the intensity of separation becomes less as the separating layer is greater in thickness Separate coloured discs upon the black area skate about not only without being absorbed, but without even spreading, and show much of the behaviour of impacting bodies, and they can be increased to a thick colourless stream flowing across the black film without altering its character, another evidence of differences of surface energy So also a bubble, partly black, is expanded and contracted only by variation in thickness of the coloured portion, the black area remaining constant despite very large changes of diameter, but coloured areas, although to a less extent, do display mutual repulsion and maintained separation

Such matters of actual observation lead to views on stability that may be epitomised as follows Stability in a soap bubble is possible only where the disruptive action of surface tension is overpowered by structural cohesiveness, surface action however, being vital to ordinary thinning, any local fault or developed weakness in the structure results in instantaneous collapse The protection provided by an enclosure freed from floating solid matter or spray or deleterious volatile material is necessary, but the bubble is likely to be stable only when its composition is maintained sufficiently uniform throughout the thinning process to allow of the production of layers of equal or approximately equal surface activity and therefore cohesion Otherwise too sudden local changes of surface energy will cause rapid sweeping up or local aggregation of these layers, and a closed vessel has the obvious further use of facilitating the desirable uniformity

For the purpose of encouraging simple experimentation it may be added that, so far as the quality of the materials is concerned, it is doubtless true that highly purified oleic acid is advantageous for special observations, but perfect success and stability are readily secured with good oleic acid purified by the old Allen method (warm treatment with successive small proportions of lead oxide, etc) This ensures a sufficient absence of saturated acids, which produce unworkable variations in viscosity, or even, as Lawrence has recently shown, solidifiable stratifications with consequent ' faults ' in film structure

W J GREEN

Royal Institution,
London, W 1, April 17

Measurement of Relative Specific Heats of Gases at High Temperatures

IN two recent papers [1] a new method has been described for measuring the specific heats of gases The essential part of the particular form of apparatus described is a calorimeter containing an iron tube, which is heated by an electric current, so as to raise the temperature of its centre some 10° C above that of its ends Two thermojunctions placed symmetrically each side of the centre of the tube, and therefore at points initially at the same temperature, are connected in opposition to a galvanometer It was shown that when a gas flows through the tube, the resulting deflection of the galvanometer is an accurate measure of the heat capacity of the gas Although this method has already been used with success up to temperatures of 600° C by placing a calorimeter of this type in a suitable oven, serious technical difficulties are likely to be encountered at considerably higher temperatures In this letter a modification of the method will be described which is very well suited for the measurement of relative specific heats at high temperatures

A long platinum tube, which in the preliminary experiments to be described had a length of 25 cm. and an external diameter of 1 5 mm, has its ends maintained at room temperature and is heated by passing through it an electric current Except near the ends the tube will have a uniform temperature of, say, 1300° C The distance from the ends at which this uniform temperature is appreciably attained depends on the thermal conductivity of the tube and on the heat loss For the tube used at 1300° C, this length is about 6 cm, leaving the central 13 cm of the tube at a uniform temperature The tube is now cooled (or heated) slightly at its centre, so as to produce a temperature drop (or rise) of, say, 20° C This can be done in many ways, perhaps the simplest being to increase the radiation loss from the centre of the tube by attaching there a small piece of platinum

It has been shown (loc cit) that the heat transfer H between a tube and the gas flowing in it, is given, to a first approximation, by $H=Q\frac{d\theta}{dz}$, where $\frac{d\theta}{dz}$ is the temperature gradient along the tube and where Q is the heat capacity of the gas passing in unit time Thus

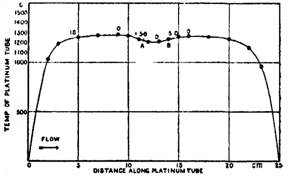

FIG 1

when a gas flows through the platinum tube the temperature distribution will be altered, the parts where the gas is rising in temperature being cooled and vice versa But the temperature of the two uniform temperature parts of the tube will not alter since there $\frac{d\theta}{dz}=0$ Hence the *central* part of the tube, with its temperature dip of 20° C, will have its ' ends ' maintained at the constant temperature of 1300° C It will therefore serve to measure the relative heat capacity of gases between 1280° C and 1300° C

The essential feature of this method is the existence of the two uniform temperature parts of the tube separating the shallow central dip from the steep gradients near the ends These parts serve to make the temperature distribution near the centre quite independent of what happens near the ends, even when a gas is flowing in the tube This method therefore enables one to measure the relative specific heats of gases over, say, a 20° C range at 1300° C, with an apparatus in which the only part heated at all is a narrow platinum tube

A convenient method of measuring the temperature changes due to the flow is to project images of two short lengths of the tube, situated symmetrically at A and B on each side of the central dip, on to two thermopiles These are connected in opposition to a galvanometer and the deflection of this, due to a gas flowing in the tube, will be proportional to the flow

rate multiplied by the mean specific heat between 1280° and 1300° C. The curve in Fig. 1 shows the temperature distribution, measured with an optical pyrometer, obtained in some preliminary experiments. The numbers against the curve are the measured temperature changes in degrees centigrade due to a flow of air from left to right. In spite of the large cooling (40° C.) near the end, the temperatures of the uniform parts are unchanged. This gives experimental demonstration of the practicability of the method. The actual dip shown of 60° C. and the flow rate of 70 c.c. per minute are both too large for actual determination of specific heats.

By using platinum iridium tubes the method should be feasible up to 2100° C., and with certain gases in tungsten or molybdenum tubes up to even higher temperatures.

P. M. S. BLACKETT.
L. K. RIDEAL.

Cambridge.

[1] Blackett, Henry and Rideal, *Proc. Roy. Soc.*, vol. 126, p. 319; 1930; and Blackett and Henry, *Proc. Roy. Soc.*, vol. 126, p. 333; 1930.

Mortality amongst Plants and its Bearing on Natural Selection

IT is a familiar fact that the majority of plants produce a vastly larger number of offspring than can possibly survive, but unfortunately exact quantitative observations respecting their mortality is meagre in the extreme.

In the course of collecting data for ecological purposes, certain facts have come to light regarding the death of young plants which, if typical, would appear to be of fundamental importance in any estimate of the incidence and intensity of natural selection. By briefly indicating here the nature of these preliminary observations, it is hoped that other investigators may be induced to record their experience and to collect data of a similar character so that it may be possible to judge as to how general is the phenomenon in question.

A typical example is furnished by *Silene conica* L. This plant, which is one of the steppe species in the flora of Great Britain, behaves as a winter annual. The seedlings germinate in September, and on a marked quadrat there were present, soon after germination, no less than 175 seedlings per square decimetre. By Nov. 23, whilst still in the cotyledonary stage, the number of seedlings had become reduced to 110, whilst by Jan. 31 only nine survived. There is thus not only a very high mortality amounting to nearly 95 per cent, but also the important fact is that this mortality was entirely confined to the seedling stages. All the mortality occurred prior to the formation of the second pair of foliage leaves, and all the nine survivors will clearly attain the flowering condition. A large plant of *Verbascum Thapsus* L. produced several hundred thousand seedlings, of which, however, all but 108 died during the first six months. All the survivors which attained the rosette stage flowered and produced seeds. Similarly, the winter annual *Ranunculus parviflorus* L. in Cornwall produces large numbers of viable seeds, and sometimes the seedlings are seen in great abundance, but in an experience of this species extending over several years close observation both in culture and in the feral state, it is evident that practically the whole mortality occurs prior to the rosette phase and that almost all the individuals which attain this condition produce flowers and fruits.

Observations on the spring germinating *Helleborus viridis* L. showed a mortality of more than 50 per cent in the first month, and observations on *Cochlearia danica*, *Dianthus prolifer*, and other species would appear to warrant the conclusion that, in these plants at least, the mortality and therefore the operation of natural selection is almost entirely confined to the juvenile stages of development. Observations on seedlings of *Fagus sylvatica* after the 'mast' year of 1922 indicate that this is true also of arboreal species. In the case of two species of *Silene*, namely, *Silene conica* and *Silene anglica*, the mortality in the plants under observation, took place at so early a stage that, if growing intermingled, the seedlings could only have been distinguished if at all with the greatest difficulty. Of the plants which survive to the stage when the distinctive external specific and generic characters appear, almost all produce flowers and fruit and probably yield offspring.

Field observations suggest that the incidence of mortality described may well be of general occurrence. Certainly in the instances cited it would appear that the adult characters, apart from those concerned with efficient pollination and seed dispersal, can play no direct part in determining survival, but that in so far as survival is dependent upon the structure and physiology of the species, it is the characters of the juvenile, not the adult, which are important. When mortality does occur in the more adult phases of development, it is generally the result of catastrophic causes which destroy the fit and unfit with equal impartiality.

If the adult characters upon which we rely for taxonomic distinctions, apart from the exceptions mentioned, owe anything to natural selection, it must be not because of their external manifestations but because they are the inevitable consequence of those characters, probably internal, which determine survival in the juvenile stages. Any selection which might occur in the adult phase will clearly be connected with the direct production of viable seeds by individuals and not by a selection amongst progeny.

The actual selection amongst the progeny of individuals, the classical *modus operandi* of natural selection, would then appear to occur almost entirely in just those phases of development which show the greatest similarity between species, those phases which show the least divergence of morphological type. If then natural selection be an important factor, the uniformity of the juvenile morphology and the great diversity of that of the adult present natural selection in the guise of a factor tending towards homogeneity rather than towards the divergence of type which it has usually been supposed to bring about.

L. J. SALISBURY.

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University College, London,
May 7.

Methyl Glyoxal as an Intermediary in Fermentation

WHILST the earlier work on fermentation, especially Prof. Neuberg's investigation of the *second form of fermentation*, rendered the participation of methyl glyoxal as an intermediary stage probable, proof that methyl glyoxal is formed by systems capable of fermenting or glycolysing sugar has been obtained by the recent work of Toenniessen and Fischer (*Zeits. physiol. Chem.*, **161**, 254), Ariyama (*Jour. Biol. Chem.*, **77**, 395), and especially by Neuberg and Kobel and various collaborators (*Biochem. Zeits.*, **203**, 463, and later papers). The latter workers conclude that methyl glyoxal is only dismuted or fermented in presence of cozymase, whilst its formation takes place also in absence of cozymase if hexose phosphate is used as the substance of origin.

Its identification as a substance produced *in vivo*

raises again the question as to why methyl glyoxal is not fermented when added to yeast or yeast preparations With glycolytic systems, no such difficulty arises, as the glyoxalase of Dakin and Dudley (Neuberg's keto aldehyde mutase) provides an enzyme system capable of acting on added glyoxals Prof Neuberg has suggested as a hypothesis that methyl glyoxal, in order to be fermented, has to be present in one of the many tautomeric forms theoretically possible for this substance, perhaps some enol or ring form

The first transformation that methyl glyoxal undergoes in fermentation, its oxidation to pyruvic acid, appears to be a dismutation, in which acetaldehyde is simultaneously reduced to alcohol It is not possible on the present evidence to decide whether an aldehyde mutase of the type discovered by Parnas and by Battelli and Stern is responsible for this transformation , a close analogy is, however, suggested by recent work of the Euler school (particularly Euler and Myrbäck (*Zeits physiol Chem* , **165**, 28) which shows that the necessity for cozymase is characteristic for aldehyde dismutations Since dismutation is typical for substances possessing a free - CHO group, and independent of the structure of the rest of the molecule, one would expect methyl glyoxal to be fermented in its - CO - CHO form and not in some enolic modification It is interesting that according to Ariyama (*Jour Biol Chem* , **77**, 359) the lactic acid formed from methyl glyoxal by liver extract accounts quantitatively for the methyl glyoxal disappearing , that is, all methyl glyoxal is destroyed by internal dismutation, none undergoing the ordinary aldehyde mutation to CH_3 CO COOH and CH_3 CO CH_2OH

Work by me (*Biochem Jour* , in the press) has shown that phenyl glyoxal, though reacting in a peculiar way with di-amino acids, does not show the reaction with mono amino acids typical for the - CHO group It is known that phenyl glyoxal forms a stable hydrate, and this peculiarity might explain its refusal to behave as an aldehyde, which is also shown by the sluggish way in which it reduces Fehling's solution According to unpublished work by Mr Pirie, chloralhydrate also does not react with mono amino acids Enolisation might also explain this peculiarity of phenyl glyoxal, but the readiness with which it forms osazones, glyoxalins, and so on, shows that if enolisation does take place in solution, it must be easily reversible Methyl glyoxal resembles phenyl glyoxal in its chemical reactions and in its behaviour towards glyoxalase It also forms a stable hydrate (as shown, for example, by its great heat of solution) and it seems probable that methyl glyoxal is not fermented, because, in solution, it does not possess a free - CHO group, One would then assume that methyl glyoxal formed *in vivo* exists at first in the - CO CHO form, and is normally oxidised before it has time to take up water Any methyl glyoxal escaping and passing into the inactive form would presumably be removed by glyoxalase

The question remains as to why the internal dismutation under the action of glyoxalase is not similarly inhibited It must be kept in mind that the above argument only applies to reactions which require a free - CHO group Since in the action of glyoxalase both carbonyl groups of the glyoxal are concerned, it seems possible that the point of attack of the enzyme is at the keto group The examples of chloralhydrate and mesoxalic acid show that stable hydration of a carbonyl group is dependent upon the neighbourhood of strongly negative groupings , in glyoxals the keto group is responsible for the untypical behaviour of the adjoining - CHO Hence reduction of the - CO - to - CH OH - group, or even the reaction of the - CO - group with the combining group of the enzyme, might enable the terminal carbonyl to react as a normal aldehyde group

J O Giršavičius

School of Biochemistry,
Cambridge, April 24

Quantitative Analysis by X-Rays

No doubt it is at present true that X ray analysis is more sensitive in detecting a trace of an element of high atomic number dispersed in an element of lower atomic number than it is in the reverse case For that and other reasons given by Prof Hevesy (Nature, May 24, p 776), the sensitiveness is variable As the result of experience gained with non metallic substances, the sensitiveness was stated in 1925 to be roughly 0 1 per cent, and we assumed that would be true for metals On making careful tests, in which we had the assistance of chemists experienced in the requisite analysis, the method was found to be more sensitive than that for all impurities in zinc of higher atomic number than chromium Evidence is given (see Eddy, Turner, and Laby, *Proc Roy Soc* , **124**, p 163 , 1929) that the elements 24 Cr, 25 Mn, 26 Fe, 27 Co, 29 Cu, of atomic number less than 30, as well as nine elements of atomic number greater than 30, can be detected in 30 Zn, although none, it is believed, was present to more than about 0 0005 per cent, and one, 33 As, gave its $K\alpha_2$ (and probably its $K\alpha_1$) lines well enough to be measurable to 1 X U , when present by chemical analysis to less than 0 00001 per cent Thus evidence is given in ths paper quoted that the *K* X ray spectrum of an element present to less than 0 0001 per cent in a metal can be photographed Prof Hevesy disagrees with this statement It should be admitted that up to some months ago we had not obtained that sensitiveness when using non metals, but there appears to be no theoretical reason why the technical difficulties met with should not be overcome Has Prof Hevesy evidence that ths sensitiveness mentioned cannot be obtained with a metal ?

Within the limits of space allowable it is not possible to discuss here what Prof Hevesy writes with reference to quantitative analysis more than to emphasise that Dr Eddy and I did not use a reference method in most of the experiments described in *Proc Roy Soc* , **127**, p 20 , 1930 , that is, in calculating the composition of an alloy, no use is made of an alloy of known composition Chemical analysis (or synthesis) was only used to verify the results so calculated The assumption made and verified is "that the ratio of the number of atoms of two elements in an alloy of metals of nearly equal atomic number is equal to the ratio of the intensities of the corresponding lines (say the $K\alpha_1$ lines) in the spectra of the elements provided the lines are excited under equivalent conditions" We believe that this principle, and the method which has been worked out to apply it, will prove of value in atomic analysis by X ray spectroscopy, and make it less empirical than it has been, although it is obvious there is considerable scope for improvement in that respect This advance should be attainable by a further study of the physical phenomena involved

X-ray analysis is being applied much more than might be inferred from the literature of this subject In our experience it is more readily applied to the atomic analysis of metallic than non metallic substances, which means it is more immediately susceptible of application in metallurgy than in mineralogy, although Profs Hevesy and Coster and others have of course obtained most valuable results in the latter field

T H Laby

London

Early Chinese Rice

AN unusually detailed account of the discovery and utilisation of a 'sport' occurs on page 470 of the 1859 edition of an English translation of "The Chinese Empire," by Monsieur Huc. The account may be of interest to agriculturists and geneticists. The book is not often met with, and indeed I have had no opportunity of consulting the French original.

'I was walking,' says the Emperor Khang hi, 'on the first day of the sixth moon, in some fields where rice was sown, which was not expected to yield its harvest until the ninth. I happened to notice a rice plant that had already come into ear; it rose above all the rest, and was already ripe. I had it gathered and brought to me: the grain was very fine and full, and I was induced to keep it for an experiment, and see whether it would on the following year retain this precocity, and in fact it did. All the plants that proceeded from it came into ear before the ordinary time, and yielded their harvest in the sixth moon. Every year has multiplied the produce of the preceding, and now for thirty years it has been the rice served on my table. The grain is long, and of a rather reddish colour, but of a sweet perfume, and very pleasant flavour. It has been named *ya mi*, or 'Imperial rice', because it was in my gardens that it was first cultivated. It is the only kind that can ripen north of the Great Wall, where the cold begins very early, and ends very late, but in the provinces of the south, where the climate is milder, and the soil more fertile, it is easy to obtain two harvests a year from it.'

M. Huc adds that this rice was introduced into Manchuria, and that it succeeds admirably in dry countries, having no need of perpetual irrigation. He thought it would certainly prosper in France, but although he sent several samples to that country he never heard that any experiment was tried with it.

Two French books allude somewhat vaguely to this rice. "Le Rapport sur les Céréales: Exposition Universelle" (Paris, 1878), mentions the above story and offers the alternative name *riz precoce*. 'Les Plantes de grande culture' (Paris, 1893) says that there appears to be a variety of rice in China which completes its growth in less than three months.

The variety is probably identical with the *yu mi* (*Oryza communis pyrocarpa* Al.) which is the only variety specifically attributed to China by M. A. Carleton ("The Small Grains", New York, 1916).

The emperor Khang hi reigned from 1662 until 1723.

HUGH NICOL.

Rothamsted Experimental Station,
Harpenden, Herts, May 3.

Raman Spectra of Crystalline Nitrates

IN a communication to NATURE of Mar. 22, p. 463, P. Krishnamurti describes some results of his experiments with powdered crystals. In a paper sent two weeks ago to the *Annalen der Physik* I have given the results of my measurements on much the same subject. By suspending the crystal powder in a liquid of suitable refractive index, and using suitable light filters, I obtained the Raman spectrum of such intensity that a spectrograph with large dispersion and very narrow slit could be employed.

Like Krishnamurti, I found a displacement of the inactive NO_3' frequency depending on the kation, and also a new remarkable difference between the anhydrous crystals and the hydrates. The frequency differences of the inactive Raman frequency of the NO_3' ion are as follows: (1) monovalent salts: lithium (anh.), 1086, lithium (hydr. $\frac{1}{2}H_2O$), 1073, lithium (hydr. $3H_2O$), 1055·5, sodium (anh.), 1067·5, potassium (anh.) 1048·4, silver (anh.), 1045·0. (2) bivalent salts: calcium (anh.) 1064·3, calcium (hydr. $4H_2O$) 1044·6, strontium (anh.), 1054·4, copper (hydr. $6H_2O$), 1052·9, copper (hydr. $9H_2O$) 1044·4, barium (anh.) 1046·5, lead (anh.), 1045·0.

Some of the wave numbers are in accordance with the data given by Krishnamurti.

Furthermore, in solutions of the nitrates, I found a variation of the NO_3' frequency with the concentration; for example, for a solution of 10 mol. $NaNO_3$ in a litre of water $\Delta\nu = 1049\cdot8$, and for a 3 mol. solution $\Delta\nu = 1047\cdot2$. For a 14 mol. solution of $LiNO_3$ the Raman difference was $\Delta\nu = 1050\cdot3$, for a 0·5 mol. solution $\Delta\nu = 1046\cdot0$.

WALTHER GERLACH.

Physical Institute,
University of Munich, Mar. 31.

Effect of Direct Current on the Frequency of Sonometer Wire

THE maintenance of oscillations of a sonometer wire by the passage of an alternating current through it has been studied in detail by Krishnaiyer and others (*Phil. Mag.*, 1922, etc.). If, however, direct current of the value of about an ampere be passed through the wire, it is found that the frequency of the oscillations, for a fixed position of the two sonometer bridges, is slightly lower than what it is when no current is passing. This effect is best observed by tuning the sonometer with an electrically excited fork placed on the sonometer board. When the wire is tuned to this frequency it begins to vibrate with a large amplitude. These vibrations are observed with a low power microscope. If the direct current be now passed through the wire, the amplitude of the vibrations is immediately reduced, and can be restored again to its original strength by shortening a little the length of the wire between the bridges.

We have verified that this lowering in frequency is not due to the heating effect of the current and is also not a magnetic effect. This effect can also be observed with an ordinary tuning fork and wires of any material.

The quantitative measurements and other interesting results will be published elsewhere.

D. V. GOGATE.
Y. G. NAIK.

Physics Laboratory, Baroda College,
Baroda, India, April 10.

Band Spectra of Copper Oxide

EDER and Valenta in 1911 had observed some of the bands of copper oxide in the flame spectra of all copper salts. Hertenstein observed them in the flame of the arc in air in 1912. R. S. Mulliken (*Phys. Rev.*, 26, 4, 1925) also noticed them while working on the spectrum of CuI as excited by active nitrogen. They would appear better by a small leakage of air into the halide vapour, or the presence of a little oxygen in the nitrogen used. I have obtained these bands by arcing between copper electrodes in an atmosphere of oxygen. They are degraded towards the red and occur in pairs, of which the shorter wave length component is relatively weak. Their rotational structure reveals that the system is due probably to a $^2\Sigma \rightarrow {}^2\Sigma$ transition. The frequencies of vibration for infinitesimal amplitude are found to be approximately 620 cm.$^{-1}$ and 345 cm.$^{-1}$ for the final and initial states respectively. A detailed investigation will be published elsewhere.

P. C. MAHANTI.

Applied Physics Laboratory,
University College of Science,
University of Calcutta, April 4.

New Light on Vision *

By Prof G ELLIOT SMITH, F R S

MAN alone among living creatures really sees the world in the sense that we usually associate with the verb 'to see' The apes and monkeys are provided with eyes which are closely similar in structure to those of man and on the functional side are perhaps equally efficient dioptric instruments Man's comprehension of what he sees, however, and his understanding of the world of things and actions revealed by his powers of visual discrimination, clearly transcend those of the apes, to which we have no reason to attribute the human quality of understanding what is revealed by sight, of appreciation of beauty, and the subtler forms of actions such as facial expression, or of possessing the initiative and skill that result from the wider vision

Investigation of the comparative anatomy of the brain reveals the fact that within the natural order of mammals (Primates), to which man belongs, the cerebral connexions of the optic tracts have been so profoundly revolutionised that what is virtually a new instrument of vision has been evolved The progressive cultivation of this 'new vision' (see NATURE, April 28, 1928, p 680), eventually led to the emergence of those profound changes in the whole organism which transformed an ape into a human being and conferred upon him the distinctive attributes of mind and skill which are the outstanding tokens of his humanity

The factors involved in the making of the mind fall into several distinct phases The acquisition of definite representation for touch, vision and hearing in a newly evolved area (neopallium) of the cerebral hemisphere was responsible for the emergence of mammals It conferred upon vision not only the possibility of closer integration with other kinds of sensory experience, but also a greater influence in the conscious control of behaviour The birth of a new cortex created a new type of animal profoundly different in every part of its organism and especially in its potentialities In particular the evolution of the neopallium involved the transference to the cerebral hemisphere of the control of voluntary movements and that led to far reaching changes in the parts of the brain and spinal cord concerned with muscular activities The new cortex established direct connexion with the spinal cord, new links with the cerebellum which provoked the evolution of a new element in that organ, and corresponding transformations of the cerebral and cerebellar connexions with all other parts of the central nervous system involved in the control and regulation of movement This remaking of the brain involved the usurpation by the new cortex of many of the functions of the midbrain

The next phase is displayed in the Primates, in which the increasing dominance of vision accentuated the process of transference to the neopallium of the control of movement The increasing concentration of visual functions in the cerebral cortex conferred upon vision a fuller participation not merely in the affairs of conscious life but also in the regulation of motor behaviour, and integrated visual, tactile and motor experience with the kinæsthetic products of the animal's own movements, the consciousness of the postures and actions of its own body The cortex came to play a part

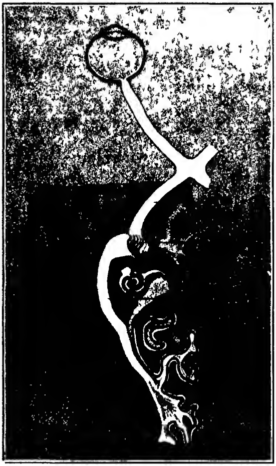


FIG 1

in the control of posture, and this conscious activity eventually conferred upon man not only the erect attitude, but also that intimate integration of skill of hand and eye with the no less important factors we call balance, poise, and rhythm, which with perfection of timing are the essential elements in dexterity

The nervous system was first called into being to facilitate the performance of rapid and precise movements In the direction of these activities an important part has always been played by the eyes Long before they were capable of true vision, such

* Friday evening discourse delivered at the Royal Institution on Mar 14

as the appreciation of images, they were instruments for recording movement in the outside world, and for guiding the animal's own movements Throughout the whole of its subsequent history the refinement of muscular skill has been intimately associated with the progressive modification of the nervous system In its highest manifestation the making of the mind was in large measure due to manual dexterity, the exploration of space with hand and eye and the integration of the knowledge of the world acquired by vision with the intimate personal experience of the movements of our joints

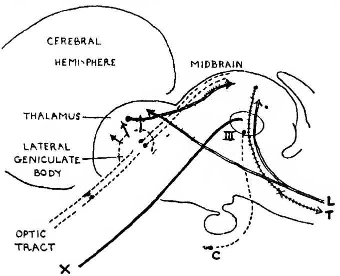


FIG 2

The comparative anatomy of the brain reveals the fact that the progressive development of vision is strictly conditioned by the ability of the hands to be used as skilled instruments It seems that manual dexterity is an implicit condition for the attainment of biological usefulness for the refinement of visual discrimination Vision could not have extended the range of its powers and influence in the Primates if their hands had not escaped the specialisation which in other mammals restricted their power of adaptation

The integration of vision and muscular skill is a complex process The heightened powers of vision provide direction for the acquisition of skill—and the cultivation of skill involves not the hands only, but also the whole body, which is essential for the maintenance of the appropriate posture as well as for the performance of movements that contribute to the successful action of the part, such as the hand, upon which the visual attention is fixed This participation of the whole organism in any act of skill contributes (in some way that we do not understand) to the development of the intricate co ordinations involved in the conjugate movements of the eyes, which in mammals are the essential preparation for the attainment of the fullest cultivation of binocular vision, the development of a macula and fovea, and the ability to see stereoscopically and so add a third dimension to spatial discrimination In addition the proprioceptive impulses from the eye muscles, as well as from the muscles and joints involved in any movement, add their quota to the integration and link the process of spatial appreciation with the personality of the individual This coherence between vision and skill is the essential mechanism for the making of mind and for giving it its distinctive individuality as an intimate part of the personality The practice of manipulation to satisfy visual curiosity which is aroused in its most intense form when the macula is developed, necessarily led to the cultivation of tactile discrimination and stereognosis Visual perception and conception are products of the integration of these factors with vision and as the result the progressive evolution of intelligence

Bearing in mind these considerations the facts of the comparative anatomy of the brain take on a new significance, and in turn features which hitherto have been overlooked can be detected in the brain when the fuller understanding of its working suggests the search for them

In the human brain (Fig 1) the fibres of the optic tract end for the most part (probably not less than 95 per cent) in the lateral geniculate body, where they transfer the impulses coming from the eyes to a new tract of fibres, the optic radiation, which carry them to the visual receptive area now commonly known as the 'area striata' (*Proc Roy Soc*, p 62 1904) This almost exclusively cortical connexion of the pathway leading from the eyes is a token of the fact that in man vision is brought into the full light of consciousness It had lost

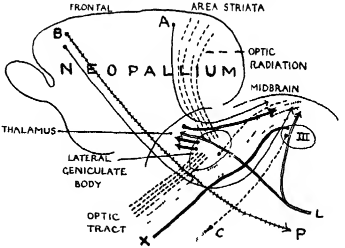


FIG 3

most of those automatic and unconscious photo static influences that are so obtrusive in most other living creatures Vision is the foundation of intelligence and the chief source of our knowledge

This distinction can be graphically displayed by means of three diagrams In the reptilian ancestor of mammals (Fig 2) the optic tract, in spite of the wide currency of Monakow's diagram, does not establish any connexion with the cerebral cortex Most of its fibres end in the midbrain, from which tracts (T) proceed to the motor nuclei in the brain and spinal cord In addition to this connexion, which automatically directs the movements of the animal, there is also a group of fibres (X), which forms part of the light reflex mechanism, using the oculomotor nucleus (III) and the ciliary ganglion (C) to influence the iris and the size of the pupil

Most of the fibres of the optic tract are functionally related to these unconscious activities The number of fibres concerned with the conscious awareness of vision is small They pass to the lateral geniculate body and from it to the thalamus

In mammals (Fig 3) the lateral geniculate body receives a larger proportion of the fibres of the optic tract and transmits some of the impulses (by means of the optic radiation) to the newly developed cortical area, neopallium, which affords a representation of vision (area striata) in the cerebral hemisphere The transference to cortical control of functions previously performed by the midbrain necessitates the establishment of new connexions between the cerebral cortex and the midbrain, both (A) from the receptive visual area and (B) from the area which controls voluntary movements For vision and movement are intimately interrelated In addition, the assumption by the neopallium of the control of the movements of the whole body leads to a profound revolution in all the motor mechanisms in the brain and provides the visual area with opportunity to exercise a wider influence on behaviour

In man (Fig 4) all the midbrain connexions shown in Fig 2 have been lost, excepting only the light reflex arrangements (X) The visual pathway leads almost exclusively to the cerebral cortex, and more than half its fibres (M and M^1) are new elements coming from the macula lutea of the retina Only the monkeys, apes, and men among mammals have a macula and enjoy macular vision The development of this sensitive spot on the retina was not evolved until the axes of the eyes were altered to permit them to look forward and their visual fields to overlap A very complex and precise correlation between the movements of the two eyes is required (conjugate movements) to bring the two images of an object with certainty upon certain determined areas in the two retinæ These areas become the maculæ, the instruments which confer on vision greater powers of resolution and discrimination The development of macular vision led to the progressive transformation of the brain and eventually to the making of the human mind It conferred not only the ability to discriminate between the details of form, texture, and colour, but also led to an enhancement of the knowledge which became accessible to a mind intent upon satisfying the curiosity awakened by such new revelations

Binocular vision enriched by macular efficiency provided the conditions which made possible the attainment of stereoscopic powers, the conscious appreciation of a third dimension in space, the recognition of solidity and perspective A vision of the world was thus revealed to man, with an appreciation of form, colour, size, and space, and a fuller understanding of distance and movement The most significant enrichment of the sensory basis of the mind is conferred by the macula To paraphrase the account given by the late Dr Henry Watt, it ' refines and distinguishes positions and forms, and, aided by the more precise accommodation which becomes evolved in association with it, it sharpens the objects of attention and dissipates the rest " "Stereoscopy adds a new character to a

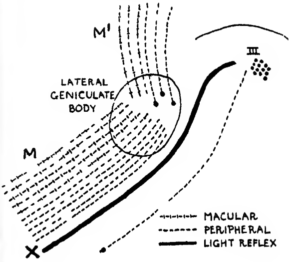


FIG 4

group of forms that may persist for indefinite periods of observation , delicate skin gives greater sensitivity to variations of pressure, and the prehensile hand implies a very great refinement in the positions and forms of the derived articular sense In the hand this becomes a fine mobile tridimensional sense which, like the stereoscopic eye, can go round and through things, so almost isolating them from their surroundings "

When in response to the visual curiosity excited by the new vision of the forms, textures, and colours of objects, the hand, under the guidance of the eyes, examines these objects, and explores their positions in space, not only is tactile information added to visual knowledge and integrated with it, but also the impulses from the joints, muscles, tendons, and in fact from the whole body, recording the effects upon the organism of the accomplishment of the action, are added to the visual, tactile, and motor sources of knowledge Hence, as Dr Watt expresses it, " the articular sense is the conscious correlate of action and of the individual's share in

his experiences " Thus " action enters into the data of sense to integrate with it and so build up psychical mind stuff "

The consciousness of action makes possible ' the integrations of percept and probably of concept that are the beginnings of intellect " It adds the essential personal element in the process of inter action of mind and mechanism, and the interpretation of the means whereby motor skill creates mind For " the first purpose of the mind is to serve the ends of action It is not merely a speculative instrument given to man that he may form for himself a disinterested knowledge of the world, create and enjoy works of art, and plan an elysium of happiness and love " It is primarily a means for seeking actively, under the guidance of attention and interest, the objects of its own desire, and for expressing in movement and other forms of behaviour the satisfaction of the impelling appetites Vision and touch are closely integrated with movements and feelings and the affective results of such expressions of the mind's searching for satisfaction

This brings us back once more to the essential fact one is trying to make clear in this discourse Man's intellectual pre eminence is based primarily on the evolution of macular vision in a Primate with adaptable hands which attained the erect attitude when the cerebral cortex under the conscious influence of vision came to control and regulate posture The profound and widespread effects of this revolution upon the structure and functions of every part of the brain—cerebral hemisphere, cerebellum, red nucleus, substantia nigra, corpus

FIG 5

striatum, midbrain, and hindbrain—will not be discussed in this discourse But attention must be directed to some of the obtrusive expressions of this new vision in the anatomy of the optic parts of the human brain

The development of the macula was responsible for adding to the optic nerves and tracts as many new fibres (Fig 4) as the whole of the rest of the retina (peripheral) supplies In the lateral geniculate body a new receptive nucleus of corresponding dimensions is provided to transmit macular impulses to the cerebral cortex

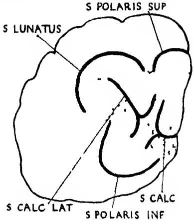


FIG 6

For many years neurologists have been speculating on the nature of the representation of the macula in the cerebral cortex During the War, Henschen's idea of the ' cortical retina ' was revised and corrected by the observations made upon wounded soldiers by Sir William Lister, Dr Gordon Homes, and many other physicians

Recently (1928 and 1929) Prof B Brouwer and his collaborators, Drs Van Heuven and Biemond, in Amsterdam, have introduced a new precision into the cortical localisation of the macula in monkeys Studying preparations of the human brain in the light of their truly epoch making investigations, one was able to detect with the naked eye a sudden change in the texture of the area striata at the place corresponding morphologically to where in monkeys Prof Brouwer and his colleagues located the boundary between the peripheral and macular territories

A drawing of the photograph (the negative) of a horizontal section through the posterior pole of a human cerebral hemisphere is reproduced in Fig 5 The area striata, distinguished by the presence of an intracortical black line, is seen to undergo a sudden change in character as the peripheral part (*P*) on the medial surface is traced backward At the point marked by the white arrow the thickness of the black line is reduced and the pale band on its inner side disappears The macular cortex begins at this place and extends around the pole on to the lateral surface of the hemisphere to end (at *M*) at the lip of a deep furrow (lunate sulcus) As this lateral part of the area striata is much broader than the medial part (*P*) exact measurements reveal the fact that the macular part is at least as extensive as the whole peripheral part

It is possible also to identify the macular part of the area striata in many human brains by simple observation of the morphological features of the surface of the cerebral hemisphere Looking at the

posterior aspect of the hemisphere (Fig 6 represents the pole of the left hemisphere) three semilunar sulci—lunatus, polaris superior, and polaris inferior—may often be seen arranged in a trefoil or shamrock leaf pattern (grouped around the calcarine sulci in the axis of the area striata) The rapid expansion of the lateral part of the area striata to afford cortical representation of the macula is responsible for the formation of opercula bounded by these three semilunar sulci Hence the presence of this cortical shamrock pattern affords definite evidence of the position and extent of the macular area It is so situated in relation to the other cortical areas as easily to be linked up with them in the functions of wider vision, which involve the activities of the cerebral hemisphere as a whole—the process of mind building upon the foundation of macular vision

It is a matter of such vital importance not to overlook the part played by action in mind making that the argument may be emphasised once more, When under the guidance of vision some delicate manipulation is performed, in addition to the success or failure of the mechanical operation, and the emotions of satisfaction or disgust which the results of the attempt and the attendant circumstances excite, the action itself starts a series of impulses from the joints, muscles, tendons and from other parts of the body, which integrate the whole process with the intimate texture of the individual's consciousness and personality The appetites and feelings which prompt the action, no less than the discriminative experience and knowledge which play their part in determining whether it is worth doing and how to do it, become associated with the activities of the whole organism during the progress of the movement It is no longer a mere matter of muscular contraction under visual control, but a complex process of integration of experience and of creating understanding and intellect

Canadian Hydro-Electric Power Development during 1929

By Dr Brysson Cunningham

THE recent issue of two reports[1] by the Canadian Government Water Power and Reclamation Service enables a survey to be made of the expansion which has taken place during the twelve months ended Dec 31 last in the development of hydro electric power in the Dominion The review made in NATURE of July 27 last year, on the statistics then available, showed a very striking and rapid rate of progress This progress has been substantially maintained and important activities are reported from practically every province The total capacity of new installations brought into operation during 1929 amounts in round figures to 378,000 horse power, bringing the aggregate for the whole Dominion to 5,727,162 horse power, as compared with 550,000 h p and 5,349,232 h p respectively, for the year 1928

Table 1 shows the available and developed water power of Canada as determined to Jan 1, 1930 The available power is scheduled in columns 2 and 3 under two heads according to the period of availability These figures are based on a computation of data relating to rapids, falls, and power sites generally, of which the actual fall or the possible head of concentration is definitely known, or, at least, well established There are many other rapids and falls of greater or less capacity scattered up and down the country which are not yet included in the register and can only become available for tabulation when the necessary survey work has been undertaken and completed This is particularly the case in the northern parts of the Dominion, where much exploration remains to be done Moreover, there are possibilities of power concentration on rivers and streams of gradual gradient which have not been taken into account, except at such selected points as have been the objects of actual study and observation Altogether, as a record of potential resources, the figures in columns 2 and 3 may be looked upon as minimum values Indeed, the basis of valuation itself is appreciably below the standard of development obtained in cases of actual installation by so much as 30 per cent If the necessary correction be applied, it will be found that the present recorded water power resources of the Dominion will permit of turbine installations aggregating about 43,700,000 horse power

TABLE 1—AVAILABLE AND DEVELOPED WATER POWER IN CANADA, JAN 1, 1930

Province	Available 24 hour power at 80 per cent efficiency		Turbine Installation (h p)
	At Ordinary Min Flow (h p)	At Ordinary Six Months Flow (h p)	
British Columbia	1 931 000	5,103 500	559 792
Alberta	390 000	1 049 500	70 532
Saskatchewan	542 000	1 082,000	35
Manitoba	3 309 000	5,344,500	311,925
Ontario	5 330,000	6,940,000	1,952 055
Quebec	8 459,000	13,064 000	2 595,430
New Brunswick	68 600	169,100	112 631
Nova Scotia	20 800	128,300	109,124
Prince Edward Island	3,000	5,300	2 439
Yukon and Northwest Terr	294,000	731,000	13 199
Canada	20,347,400	33,617,200	5 727,162

The actual installation to the end of 1929 in water wheels and turbines, as shown in column 4, amounted to 5,727,162 horse power, representing slightly more than 13 per cent of the recorded potential resources

The progressive development which has taken place since the beginning of the present century is best illustrated by a diagram, and the curve shown in Fig 1 is remarkable not only for its continuous

upward trend but also for the increasing degree of steepness which characterises its progress It is

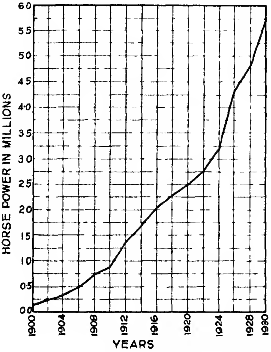


FIG 1 — Growth of water power development in Canada 1900–30

surprising to realise that thirty years ago hydro electric installations in the Dominion did not amount to one quarter of a million horse power

Obviously it is impossible in the space at disposal to allude in any detail to the various installations which have materialised during the past year A few observations on one or two stations of outstanding importance is all that may justifiably be attempted in this brief review of the general situation

The province of Quebec led the way with an addition of more than 208,000 horse power brought into operation, including chiefly the new plant (72,000 horse power) of the Montreal Island Power Company on Des Prairies River, near Montreal, and additional units to the existing stations of the Gatineau Power Company and the Shawinigan Water and Power Company The Gatineau Power Company added fourth units of 24,000 h p and 34,000 h p respectively to the stations at Farmers Rapids and Chelsea Dam, illustrated in NATURE of July 27, 1929 A third station on the same river at Paugan Falls, a view of which is shown in Fig 2, has a present equipment of 204,000 horse power which is shortly to be increased to 272,000 horse power The same Company also completed the construction of a storage dam at Cabonga Lake, an important upper tributary of the Gatineau River, providing a reservoir with a capacity of 45 thousand million cub ft This reservoir is the property of, and is now being operated by, the Quebec Streams Commission in conjunction with the Baskatong reservoir above the Mercier dam, with a capacity of 100 thousand million cub ft, located lower down the river The Shawinigan Water and Power Company added a 43,000 horse power unit (eighth in succession) to No 2 Shawinigan Falls Station (vide NATURE, Sept 3, 1927)

Important projects are in hand at Chute a Caron on the Saguenay River, where four units of 65 000 h p each are about to be installed and at Beauharnois, on the St Lawrence, immediately above Montreal, where an initial installation of 200,000 or possibly 350,000 h p is projected before the end of 1932 This latter outstanding undertaking includes a diversion canal for power and navigation, approximately 15 miles in length The inauguration of constructional operations by the Governor General of Canada was referred to in NATURE of Dec 14, 1929, p 930, in which some particulars of the project were given

FIG 2 — Gatineau Power Company's development at Paugan Falls on the Gatineau River Quebec Present installation, 204 000 h p ultimate 272 000 h p By courtesy of the Dominion Water Power and Reclamation Service Ottawa Canada

The province of Ontario includes the renowned Niagara Falls, or, at any rate, a portion of them During 1929, work was advanced on the installation of a tenth unit of 58,000 horse power at the Queenston Station, it is expected to be completed this year Another important development was the completion of the 28,200 horse power installation of the International Nickel Company of Canada at the Big Eddy Dam on the Spanish River

Table No 2 enables an idea to be formed of the distribution of the developed power among the leading industries in the various provinces Supplies to central electric stations constitute by far the major portion of the consumption and there is every indication that the proportion used for this purpose will continue to increase From a percentage of 33½ at the beginning of the century it has grown to more than 84 per cent A number of factors contribute to this increasing use, notably the extensive economic radius of modern electrical transmission, combined with the fortunate location of water power sites in relation to centres of population and industry without adequate local fuel supplies The provinces of Ontario and Quebec, as is well known, are entirely destitute of geological deposits of coal The special adaptation of hydraulic power to central electrical station operations is emphasised by the fact that the last completed central station census, namely, that for the year 1927, shows that more than 95 per cent of the total main plant equipment is in hydraulic generating stations and that this equipment produced almost 99 per cent of the total electrical output[1]

It is noteworthy that at the present time there are in Canada a total of 312 hydro electric central stations, possessing an aggregate of 4,817,486 horse power, distributing supplies for purposes of all kinds, including traction, lighting, heating, and motive power generally Municipalities and public organisations control 97 of these stations, containing 237 turbines aggregating 1,297,398 horse power The remaining 215 stations, with an installation of 581 turbines and a combined capacity of 3,520,088 h p are owned by various commercial organisations

The next most important source of consumption for hydro electric power in Canada is the pulp and paper industry—the chief manufacturing activity of the Dominion One of the most conspicuous features of industrial progress in Canada has been the growth of this industry, arising out of the occurrence of enormous supplies of growing pulp wood in close proximity to readily developable water power of a magnitude adequate to provide the large supplies of power essential to the conversion of the raw material into the finished product The value of this fortunate conjunction and the importance of ample supplies of economically produced power may be gauged from the fact that practically 100 horse power is required per ton of daily output of newsprint

Column 4 of Table 2 shows the amount of electro hydraulic power absorbed in miscellaneous industries, including mining, to which it is an invaluable adjunct in consequence of the prohibitive cost of fuel power Columns 6 and 7 are of interest in instituting a comparison of power development per head of population The figure for the whole of Canada, 584 per thousand, compares extremely favourably with that of other countries, being considerably in excess of most and rarely exceeded, or indeed even approached

TABLE 2—DEVELOPED WATER POWER IN CANADA, JAN 1, 1930

DISTRIBUTION BY INDUSTRIES AND PER 1000 POPULATION

Province	Turbine Installation in h p				Population June 1, 1929	Total Installation per 1000 Population (h p)
	In Central Electric Stations	In Pulp and Paper Mills	In other Industries	Total		
British Columbia	417 960	81 000	60,832	559,792	591,000	947
Alberta	70,320	—	212	70,532	846 000	83
Saskatchewan	—		35	35	886,700	0 04
Manitoba	311,925	—		311,925	663,200	470
Ontario	1 616,773	240,880	94,402	1 952,055	3,271,300	597
Quebec	2,238 525	221,160	135,745	2,595,430	2,690,400	964
New Brunswick	83,910	19 778	8 943	112,631	419,300	269
Nova Scotia	77,697	16 008	15,419	109 124	550,400	198
Prince Edward Island	376	—	2 063	2,439	86,100	28
Yukon and North West Terr	—	—	13,199	13 199	12 400	1063
Canada	4,817,486	578,826	330 850	5,727,162	10,016,800	572

Col 2 includes only hydro electric stations which develop power for sale
Col 3 includes only water power *actually developed* by pulp and paper companies In addition to this total pulp and paper companies purchase from the hydro power central electric stations totalled in Col 2 electric energy for power purposes estimated at about 860,000 h p, making a total of about 1 438 826 h p actually used for power purposes in the manufacture of pulp and paper A considerable amount of off peak and surplus power is also purchased for use in electric steam boilers
Col 4 includes only water power *actually developed* in connection with industries other than the central electric station and pulp and paper industries These industries also purchase power from the central electric stations totalled in Column 2
Col 5 totals all turbines and water wheels installed in Canada
Col 6 shows the population at June 1 1929 as estimated by the Dominion Bureau of Statistics
Col 7 averages the developed water power per 1000 population

[1] Report No 1353 Hydro-Electric Progress in Canada in 1929, Report No 1361 Water Power Resources of Canada (Ottawa Dominion Water Power and Reclamation Service)

Obituary

DR H J B FRY

DR H J B FRY died on May 5 at the early age of forty four years, from an acute infection acquired at a post mortem examination in the course of his work at the Cancer Hospital London, where he had held the post of pathologist since 1922 In the investigation of cancer and especially in the organisation of this work by the British Empire Cancer Campaign, he had found a field for which he was, both by nature and experience, peculiarly well fitted He was educated at Charterhouse, Magdalen College, Oxford, and St Thomas's Hospital His earlier investigations, both before and during the War, dealt with a wide range of biological and clinical subjects he published papers on the coagulation of the blood in fishes and tunicates, the nervous control of the cephalopod heart the histology of the pituitary gland in diabetes and the use of immunised blood donors in the treatment of pyogenic infections He was thus well acquainted with the complexities and pitfalls of research both in the laboratory and in the wards, and he had exactly that combination of enthusiasm experience, and caution which is most needed in cancer research Moreover, at his home in Welwyn Garden City he was a magistrate and a councillor, and in these positions, and in the difficult work of a committee for placing convicted persons on probation he had gained a good knowledge of the conduct of business

As secretary of the Investigation Committee of the British Empire Cancer Campaign, it fell to Dr Fry's lot to receive those abundant suggestions, of all possible degrees of rationality, which are offered to the Campaign for the investigation and treatment of cancer He served the *Cancer Review*, which is published by the Campaign and abstracts the literature relating to cancer, from its beginning as sectional editor, and later as chairman of the editorial committee, and the volumes of this journal, of which the fifth is now being issued, contain a mass of good work by him He took endless trouble over his abstracts, and they are models of thoroughness

In his own investigations Dr Fry had attacked two of the most difficult problems, namely, the search for immune reactions which might possibly serve as some basis for the diagnosis, and for the treatment, of cancer The time given to him was too short to allow of much progress in these immense tasks, and his published writings show a beginning only His flocculation method for the diagnosis of cancer gave useful results within certain limits, and he was constantly testing possible improvements in the technique Throughout this research he worked with material from human sources, under clinical conditions, and his work could be under no reproach that it applied only to the artificial conditions of the laboratory

In his recreations Dr Fry was a fine athlete, a cricketer, tennis-player, and rider, and a lover of literature with an especial devotion to Hardy's "Dynasts" and Gilbert Murray's translations of Greek drama He was not a man who spoke of his ambitions, but anyone who knew him well will have no doubt that these lay in the direction of manifold and increasing service to human welfare

DR GUSTAF EKMAN

WE regret to record the death at the age of seventy seven years of Dr Fredrik Gustaf Ekman From the *Göteborgs Morgenpost* of Feb 27, we learn the following details of his life Ekman was born at Stockholm in 1852, and when he was nine years old, his family moved to Goteborg, where his father and brother obtained posts in the Carnegie sugar refinery As a student at the technical high school of Goteborg and Chalmers technical institute, and afterwards at Wiesbaden and Uppsala, Gustaf Ekman specialised in scientific technology with the view of acquiring full knowledge of the technique and the chemico scientific basis of sugar refining On his return to Goteborg in 1880 he obtained the post of technical director in Carnegie's refinery, and for twenty years as technical director and then as one of its managing directors Ekman rendered considerable service to the development of the Swedish sugar manufacture

In his student days in Uppsala Ekman showed leanings towards natural science and marine research in particular appealed to him Some preliminary marine investigations were begun in 1876 in collaboration with Prof A W Cronander, professor of chemistry, and in the following year the State fitted out and financed a Baltic expedition in which Ekman participated Next year he received from the local authority in Bohuslan a request to investigate the sea off the coast of Bohuslan from the point of view of the herring fishery, and his pioneer discoveries awakened widespread interest in marine biological and fisheries research Indeed, his name will always be associated with that of his friend Prof Otto Pettersson in the annals of Swedish hydrographic work Since 1904 he was associated first as expert and later as delegate with the International Council for the Exploration of the Sea

WE regret to announce the following deaths

Dr Joseph L Markley, professor emeritus of mathematics at the University of Michigan, known for work on Bessel functions and the theory of functions, on April 20, aged seventy years

Dr William H Nichols, past president of the American Chemical Society, known for his work on the metallurgy of copper and in industrial chemistry, on Feb 1, aged seventy eight years

Prof Katsusaburo Yamagiwa, emeritus professor of pathology and pathological anatomy at the Tokyo Imperial University, member of the Japanese Imperial Academy, who carried out important investigations on cancer, showing in 1915 that it could be produced by prolonged application of coal tar to the skin, on Mar 2, aged sixty six years

News and Views

THE presidents of seven American universities have furnished the Scientific Research Committee of the American Association for the Advancement of Science with statements of the salaries paid to executive officers, professors, associate professors, and assistants in 1900 and 1925 The Universities are Yale, Harvard, Ohio State, Michigan, Illinois, Wisconsin, and California The figures, with other statistical material, provide Prof W A Noyes, of the University of Illinois, with the basis for an interesting argument published in *Science* for April 18 Dr Noyes says that professors in American colleges and universities are not receiving their fair share of the returns from the rapidly increasing prosperity of the country In the twenty five year period, nominal wages in America increased by 200 per cent, corresponding to a real wage advance of 50 57 per cent Since the nominal salary increase among professors was only 87 122 per cent, their purchasing power in 1925 was actually below the 1900 level To be equitable, a salary of 2000 dollars in 1900 should have been 6000 dollars in 1925 Dr Noyes also compares academic with scientific industrial salaries earned by his own students of the 1918–1928 class The average salary of those who had taught for four to ten years was 3472 dollars, and the average for industrial workers for the same time 5619 dollars The highest initial academic salary was 3500 dollars paid to a woman in a women's college, and the highest three initial salaries for industrial work were 4800, 4000, and 3840 dollars respectively "It seems evident", he says, "that unless these conditions can be remedied our universities must be content to fill their teaching positions with mediocre men" He puts an 'attractive' salary for a professor in present day America at 20,000 dollars (say £4000) a year

So much for the 'academic' point of view That an American business man, Mr Edward A Filene, president of a Boston commercial organisation, should discuss the salary problem from a more detached point of view seems to be an adroit move His address to the Committee does not show him to be better informed or more enlightened than some of our best men of affairs and industrialists The emphasis falls differently It is impossible to do more here than outline the salient points of an address interwoven with historical and economic allusions His points were (1) That it is idle to accuse the scholar of impracticality because he does not descend to the market place to earn a living by 'useful work' by so doing he would become useless as a scholar, and to refuse to do so is sound practicality (2) That whether the taxpayers should or should not control education need not be discussed, they cannot Prohibition of education is only theoretically possible Science has made it practically impossible (3) American business has discovered that it cannot be run on opinion, however traditionally correct and authoritative, but only by actual scientific research, which is specialists' work What is happening is not the commercialisation of scholarship, but a new revolution of economic life by science The power that comes from science cannot in modern conditions be used selfishly it will receive many times its present reward Mr Filene appears to believe that those educational ideals that really matter will be more secure in the new economic order than they are now because they are essential to the life of science and the aims of human effort Another business man, a newspaper magnate, told the Committee that he regarded scientific workers who willingly and unnecessarily laboured on a miserable stipend as "economic imbeciles" It would be unlike the Americans to leave the matter there

THURSDAY last May 29, was the three hundredth anniversary of the birth of King Charles II, an event which should be, for diverse reasons, of interest to men of science Proclaimed king on May 8, 1660, in Westminster Hall, Charles arrived at Dover, from the Hague, on May 29, his thirtieth birthday Portraits in national and private collections familiarise the King's lineaments in manhood A faithful representation of him (its particular source is not known) is seen in the finely executed pen and ink drawing in the second charter (1663) of the Royal Society As to personality, Evelyn enters him as "débonnaire, easy of access, naturally kind hearted, and of an excellent temper" In his sketch of the rise of scientific study in Scotland (1909) the late Sir William Turner goes further, remarking "Charles II lives in the recollection of most people as a lover of pleasure, untrustworthy, indifferent to the welfare of his people and ready to sacrifice the interests of his country to gratify his taste for luxury and ease" In early life Charles received tuition in mathematical studies from Hobbes, he had mechanical skill and he possessed a turn of mind which led him to discuss the philosophical topics of the period Pepys, however, noted that the King "mightily laughed at Gresham College for spending time only in weighing of ayre and doing nothing else since they sat" What justly, and in charitable construction, can we say of this monarch, then, from a point of view less relating to conduct and more to corporate effort ?

IN brief retrospect we may recall certain national institutions actually attributable to Charles II, through Royal edict, passing over special formative influences (1) The Royal Society of London took shape amongst a group of men The King might have adopted and maintained a negative attitude on the contrary, he was friendly throughout To his signature in their charter book he appended the word Founder (2) The Royal Observatory at Greenwich was built in 1675 Flamsteed records the facts concerning its establishment, and the immediate interest shown by Charles II in its foundation (3) The Royal Mathematical School of Christ's Hospital centred in a plan of education for service in the navy or in merchant craft A Royal charter, granted in 1673 by Charles II, affirmed there might be forty boys "there taught and instructed in the Art of Navigation and the whole Science of Arith-

matique untill their age and competent proficiency in those parts of the Mathematiques shall have fitted and qualified them in the judgment of the Master of the Trinity House." It is true that little was done, however, by the King towards the after maintenance of his foundation. (4) On St. Andrew's Day 1681, Charles II. granted a patent which incorporating the physicians, founded the Royal College of Physicians of Edinburgh, a recognition of the claims of the northern city which has redounded to the honour of medicine and learning. Charles II. died in 1685, and was buried in Henry VII.'s Chapel in Westminster Abbey.

IN his Friday evening discourse at the Royal Institution on May 23, on some scientific instrument makers of the eighteenth century, Mr. R. S. Whipple stated that there is little evidence to show that scientific instrument making, as a craft, had obtained a position of any importance in Great Britain before the sixteenth century. The demand for instruments to assist navigation became more insistent as new lands were discovered and the length of the voyages increased. The discovery of the telescope in 1608 and the development of the microscope, largely due to Hooke and Leeuwenhoek in the middle of the seventeenth century, gave a great impetus to the manufacture of scientific instruments. John Marshall, by his skill in developing a method for grinding lenses and by the improved designs of his instruments became the foremost instrument maker of the latter part of the seventeenth and of the early part of the eighteenth century. Benjamin Martin (1704–1782) who began life as a ploughboy, later became well known as an author of popular scientific books and as an instrument maker. He developed many improvements in the microscope and other instruments. One of his contemporaries, George Adams, became, perhaps, the best known instrument maker of the eighteenth century. He specialised in the manufacture of globes and surveying instruments, and also in microscopes. He also made a large number of instruments for George III., which are preserved in the Science Museum at South Kensington. They are outstanding examples of finished workmanship. Dolland, Ramsden, and Herschel were other outstanding instrument makers of the eighteenth century.

IN the early days of long distance telephone communication, many thought that it would be a boon if the speaker and listener could see one another during the conversation. The difficulties at first sight seem insuperable, yet apparently they have, with the important exception of cost, been satisfactorily overcome. At a Press view on April 9 in New York, the feasibility of two way television was demonstrated. An 'ikonophone' booth was erected in one building and a similar booth was erected in another building some distance away by the Bell Telephone Co. The speaker enters one booth and a 'scanning' beam of mild blue light rapidly and continuously passes over his face. As in ordinary television, this enables the listener to see the speaker. A similar beam traverses the face of the listener, thus making him visible to the speaker. The television booths themselves are lighted with a dim orange light to which the photoelectric cells are insensitive. An ordinary telephone mouthpiece cannot be used, as this would hide part of the speaker's face. The telephone transmitters, therefore, are concealed in the sides of the booth. The received image is formed eighteen times a second and is of the familiar black and pink type seen with neon reception. The increased sensitivity of modern cells and the use of the faint blue scanning beam have reduced the dazzle and glare so much that the conditions are now quite tolerable. Dr. Jewett states, however, that the terminal apparatus is at present very complicated and expensive. A description of the apparatus is given in the *Wireless World* for May 14.

IN the *Times* for May 23 an account is given of a television performance of a play which was seen by an audience of 300 people in a theatre in New York although the actors were more than a mile away in the General Electric Laboratory. The screen was six feet square and it is stated that the actors were clearly visible; also by means of loud speakers their voices were audible in every part of the building. To give variety to the entertainment one member of the vaudeville company came to the theatre after the first part of the act had been shown and the act proceeded with him playing his part on the stage while his partner was seen by television. The performance was slightly marred by the tendency of the picture to sway slightly, due probably to the synchronisation not being quite perfect. The pictures are said to have been very much superior both in definition and freedom from flickering to cinema pictures when they first began to be shown. Like everything new it is attracting audiences and the success of the demonstration has led the management of the theatre to retain television as a regular feature of their programme.

AN account has been received from Mr. A. S. E. Ackermann of the occurrence of three successive waterspouts within half an hour, at a point off the Italian coast four miles west of Portofino Vetta in the forenoon of April 20. The first was the largest, and lasted about ten minutes, while those that followed when the first had drifted away to the west each lasted about four minutes. The description of the actual spout does not suggest anything abnormal—in each case a column of spray first rose from the water, and afterwards the characteristic column of cloud descended to meet the spray, the latter rising at the same time. The cloud column would therefore appear to have developed when the parent atmospheric whirl increased in intensity. The remarkable feature of the phenomenon is the apparent repeated formation at a particular point on the sea at a time when a definite general drift of wind was evidently present, for the atmospheric conditions responsible for a spout might be expected to drift with the wind, and any reappearance of the phenomenon would naturally

be farther to leeward—unless of course there should be a nearly stationary patch of water warmer than the rest of the sea in the neighbourhood, capable of a trigger-like action upon atmospheric conditions already verging upon instability

PROF A C LANE, writing from the Library of Congress, Washington, in connexion with the discussion on geological climates at the Royal Society on Mar 27 (NATURE, April 5, p 546), raises two interesting points First, he suggests that there may have been during geological ages a slow variation in the density of the atmosphere, which would have a definite climatic effect On this it may be remarked that the great flying reptiles of the Mesozoic probably could not have lived in an atmosphere much rarer than the present, they have in fact been adduced as an argument for greater density In the absence of any real evidence, however, it is idle to speculate on the possible climatic effects of such changes The second point is of greater interest Suppose a black smoke deposit could be laid over the surface of the Greenland ice sheet, what would be the effect? The experiment would no doubt add something to the earth's heat, for part of the radiation now reflected back to space would be absorbed, and if the blackening could be maintained, there would presumably be a local amelioration of climate, perhaps comparable with that which occurred about the tenth century A D But immediately the ameliorating influence in the tenth century, whatever its nature, was withdrawn, the Greenland ice sheet increased again in extent, and one fears that any artificial attempt in the same direction would be equally transient There is room for speculation whether the existing meteorological system would remain stable under great changes of solar or geographical conditions, but there is little doubt that it is stable under small disturbances, and tends to restore existing conditions as soon as the disturbing factor is withdrawn

IT is stated in the daily Press that a conference of representatives from all over New Zealand, convened by the Government, met on May 7 in Christchurch to consider the problem of the increase of deer So greatly have the herds developed in recent years that they have spread into new areas and are becoming a menace to farm and forest lands Red deer and fallow deer were introduced into New Zealand in the sixties and seventies of last century, and since that time various other species, such as the Indian sambar, the American wapiti and moose and Virginian deer, have been set free and become firmly established The naturalisation of these handsome animals was hailed with satisfaction by sportsmen and by naturalists, who regarded their presence as an asset to a noble environment Their dispersal from the limited areas in which they were originally set free to new valleys and districts was recorded with admiration, and their safety was ensured by protection, for the deer belonged either to private acclimatisation societies or to the State, which also took a part in the introductions Twenty years ago deer were still being introduced

Now comes the announcement that the deer have become a pest, and the Minister of Internal Affairs, who presided at the conference referred to, declared that he himself favoured the removal of all protection from deer and chamois From the short cabled message it would appear that the body of the conference deemed the menace too serious to be met even by such a measure, a unanimous decision was reached that extermination was a matter of urgency, and the Government was asked to supervise the destruction of the animals Without evidence, we have no means of judging whether this was a reasonable decision on the part of the conference—there are always people who, when their interests are threatened, are ready to call for the extermination of the aggressor But even if the case against the deer is exaggerated, the venture which began in blessings and after half a century of commendation is ending in cursings, is one of the most emphatic warnings of recent years against the setting free of foreign animals in a new land

AMONG the recent acquisitions of the British Museum (Natural History) are the following The Department of Zoology has received the skin and skull of the rare East African bongo (*Boocercus eurycerus isaaci*) from the Aberdare Mountains, Kenya Colony, and also an unusually interesting collection of corals comprising about 300 specimens with full field notes, presented by Dr Cyril Crossland, by whom they were collected in the course of his investigations on the coral reefs of Tahiti Through the kindness of Mrs V D Hughes of Winchester, the Department of Entomology has received a selection of Lepidoptera from the collection of the donor's father, the late Andrew Swanzy The series includes practically all the type specimens in the Swanzy collection described by the late Dr A G Butler and figured by him in one of his earliest works ("Lepidoptera Exotica", 1869–74) Under the will of the late Prof F V Theobald, who died on Feb 11 last, his collection of Aphididæ, consisting of 9258 microscope slides carrying preparations of specimens, among which are 402 types, 19 co types, and 311 paratypes, goes to the Museum The collection includes the material upon which its late owner based his monograph "The Plant Lice or Aphididæ of Great Britain" (3 vols 1926–29), and also his reports on African and Indian Aphididæ This bequest makes the British Museum collection of this family the finest in the world The most important addition to the Geological Collections is a set of four specimens of an extinct aquatic reptile, *Mixosaurus*, from the Alpine Trias of the Lake Lugano district of Italy This genus is a somewhat aberrant form of Ichthyosaur in which the characters of several bones are reminiscent rather of land than of water animals It was about three feet long and in shape rather like a porpoise, and had paddles for swimming and an elongated tail fin The specimens purchased include a fine skull and lower jaw, the sclerotic ring of one of the rather large eyes, and a good portion of the vertebral column Paymaster Commander T M Salter, R N, has presented to the Department of Botany a collection of

1400 prepared and named South African flowering plants

RESEARCH work in Germany from 1920 to 1927 is outlined in "Deutsche Forschung", a brochure issued as an extract from the fifth Report of the Notgemeinschaft der Deutschen Wissenschaft. Its 116 pages give some idea of the immense range of activities encouraged by thousands of grants in aid during years of impoverishment. All academic studies have benefited from theology, philosophy, and philology to biology, agriculture, and medicine. Assistance has taken such forms as subventions for printing expenses of periodicals, grants to research scholars and explorers, publication of works almost completed before the War, provision of expensive physical apparatus and foreign literature. In every department it has been necessary to consider which magazines to support, and in restricting quantity to improve quality; hence two are supported for international law, three for psychology, ten for geology. The most striking venture has been the exploration of the South Atlantic by the research ship *Meteor*. Some two years were spent on about a dozen roughly parallel routes between Africa and South America. Sea and air, winds and currents, plankton and ocean floor were examined by specialists. Other leading lines have been vitamins, ultra-violet and penetrating radiations, cathode rays, vacuum tubes, and spectroscopy. Preparations have been made for total eclipse expeditions and for observations of the opposition of Eros. As a guide to recent research in Germany the book should be valuable to the historians of science and to publishers, editors, and librarians.

WE have received a copy of the Year book 1928–30 of the Sixth Achema or Great International Exhibition of Chemical Apparatus, which is to be held at Frankfurt on the Main on June 10–22. The book contains much useful information about the development of all kinds of machinery and apparatus which is designed for use in chemical technology. These descriptive sections have been compiled by well-known experts. Dr Kirschbaum of Karlsruhe gives an interesting account of the method pursued in the technical high schools of adapting the curricula to the needs of the young engineering chemist. It is recognised that the experience gained from a close and intensive study of the main processes in common use in chemical factories is much more valuable than a superficial but more comprehensive course of theoretical studies. Provision is also made for the students to complete their training by carrying out research, the experience thereby gained being of immense ultimate value to industry. Herr Jentgen of Berlin describes some of the mechanical problems encountered in the rayon industry, and other articles deal with the standardisation of plant and apparatus, both large and small. In the industrial section the characteristic properties of special rustless steels, aluminium and its alloys, and bakelite are described. There is also a section upon scientific apparatus, such as Sartorius' balances, electric high temperature ovens and apparatus for electrometric titrations. This is followed by a chapter upon various types of chemical plant and machinery. An interesting feature of the book is the inclusion of more than fifty portraits of leading German authorities in chemical technology. Copies may be obtained on sending two international postage coupons to Dr Max Buchner, Hannover.

THE May issue of the *Empire Review* contains an article on vocational psychology by Mr Eric Farmer. He points out that the subject suffered in its initial stages from too great publicity, so that uncritical people tended to believe that it was a simple matter to devise tests calculated to select those people likely to do well at any given occupation. Research, however, has revealed that vocational psychology is far more complicated than was at first supposed. The term 'vocational fitness' can no longer be limited to the narrower economic factors involved in ability actually to do a certain type of work, or produce during a test period a large output; it must also include relative freedom from accidents and sickness and satisfaction to the worker from his work. Mr Farmer discusses the principles involved in the problems both those belonging to the individual and those to the work. He criticises some of the more usual methods of devising selection tests and shows that in some cases false assumptions are made. He does not, however, imply that vocational guidance and selection are impossible, but points out that the early over-enthusiastic stage is over and that the whole subject has now entered upon a more scientific experimental period. The article is a very valuable critical survey and of importance to all engaged in this very difficult aspect of psychology.

THE Faraday Society will hold a general discussion on "Colloid Science Applied to Biology" at Cambridge on Sept 29–Oct 1. A number of workers have been invited to prepare reports on the physico-chemical problems which are encountered in biological work and especially in the study of living matter. These reports will be circulated as far in advance of the meeting as possible so that they may be fully considered by workers in the fields of physical chemistry and biology, and so that considered contributions may be made to the discussion in due course. Sir William Hardy will preside over the first part of the meeting, devoted to "Equilibrium in Protein Systems" and will give an introductory address. Those invited to present reports are Prof A V Hill, Dr R A Gortner (Minnesota), Prof E J Bigwood (Brussels) and Prof W Pauli (Vienna). Sir Gowland Hopkins will preside over a discussion on "The Structure of Living Matter" and will give an introductory address. The following have been invited to give reports: Dr Wilmer (Cambridge), Prof W H Lewis (Baltimore), Prof R A Peters (Oxford), Prof Fremiet, Prof Hans Pfeiffer (Bremen), and Dr J H Quastel (Cambridge). The discussion should prove of considerable interest, and the following prominent overseas workers, more particularly in the field of physico-chemistry, have already accepted invitations to take part: Prof E F Burton (Toronto), Prof J Duclaux (Paris), Prof H

Euler (Stockholm), Prof H Freundlich (Berlin Dahlem), Prof H R Kruyt (Utrecht), Prof Wo Ostwald (Leipzig), Prof Wo Pauli (Vienna), Prof S P L Sørensen (Copenhagen), and Prof T Svedberg (Uppsala)

The Burmese earthquake of May 5 (Nature, May 17 p 752) was followed on the next day by an equally destructive shock in north western Persia The epicentre was in the Azerbaijan district and not far from Salmas a town which lies about 80 miles west of Tabriz and 400 miles north west of Teheran The early reports estimate the loss of life as about 2000 The immediate neighbourhood of Salmas has been comparatively free for many years from destructive earthquakes though near Tabriz there is a centre that has been the source of several great earthquakes during the last century and especially in 1879 and 1883 As is stated in the *Daily Science News Bulletin* (for May 10) issued by Science Service Washington D C, there has been lately a period of seismic tranquillity unequalled in the recent annals of seismology From Dec 17 1929 to May 5, 1930 only one rather strong shock (near Borneo on Mar 26) has been recorded

Many friends of Dr G Claridge Druce assembled at the Great Central Hotel, London, on May 23, to offer him congratulations on the attainment of his eightieth birthday Sir Maurice Abbot Anderson, president of Flora's League, occupied the chair, and Viscount Grey of Fallodon gave an address on some aspects of outdoor natural history, the pursuit of which always brings delight and often leads to knowledge of significant scientific value On behalf of the Botanical Exchange Club, Lord Grey presented Dr Druce with a cheque which, it is understood, will be used by him to purchase a plot of land where a particular wild plant is found, and afterwards to hand over the land to the Society for the Preservation of Nature Reserves so that this rare plant may be preserved in England

At a preliminary meeting held at the Technical College, Cardiff, on May 21 it was decided to form a Microscopical Society of Wales, for the acquisition and diffusion of knowledge gained by microscopical research The original suggestion was for a local body, but the preliminary inquiries brought so much support that a body on a wider basis was considered feasible The committee appointed at the preliminary meeting met on May 23 and it was decided to hold an exhibition on June 2 and an inaugural meeting on June 4 The exhibition will illustrate the importance of the microscope in the sciences and will be open to the public Meetings so far have been held at the Technical College, the authorities of which have put the biological laboratory of the College at the Society's disposal on one evening weekly throughout the year Mr A F Harris, 44 Partridge Road, Cardiff, has been appointed secretary and will organise the exhibition

Sir Edward Sharpey Schafer will open the new buildings of the Department of Research in Animal Genetics of the University of Edinburgh at the King's Buildings, West Mains Road, on Monday, June 30, at noon

Mr H T Tizard, Rector of the Imperial College of Science and Technology, is to succeed Sir J J Thomson as president of the Association of Special Libraries and Information Bureaux, at the annual conference of the Association to be held at New College, Oxford, in September

The forty first annual Conference of the Museums Association will be held at Cardiff on June 23–27 under the presidency of Sir Henry Miers The provisional programme includes an address by Dr Cyril Fox on the National Museum of Wales, and another by Dr O Lehmann director of the museum at Altona Prussia papers are to be read on the opportunities and difficulties of the parent museum in connexion with museum affiliation (Dr Cyril Fox), rural services (Mr W C Sprunt and Dr F W Woodhead) geology and botany in relation to the small museum (Dr F J North and Mr H Augustus Hyde respectively) Throughout the meeting there will be an exhibition of museum cases, fittings and appliances, etc in the Engineers' Institute Park Place Cardiff The local honorary secretary for the meeting is Mr A H Lee, National Museum of Wales Cardiff

Applications are invited for the following appointments, on or before the dates mentioned —A radiologist at the Crumpsall Hospital, Crumpsall, Manchester—The Town Clerk, Town Hall, Manchester (June 2) A lecturer in electrical engineering at the Dudley Technical College—The Director of Education, Education Offices, Dudley (June 4) A part time demonstrator in chemistry at King's College of Household and Social Science—The Secretary, King's College of Household and Social Science, Campden Hill Road, W 8 (June 7) An instructor in the electrical engineering and physics department of the School of Engineering and Navigation, Poplar—The Education Officer (T 1), County Hall, S E 1 (June 7) A lecturer in mathematics at the Portsmouth Municipal College—The Secretary, Offices for Higher Education Municipal College, Portsmouth (June 7) An assistant marketing officer under the Department of Agriculture for Scotland—The Establishment Officer, Department of Agriculture for Scotland, Queen Street, Edinburgh (June 7) A graduate assistant in electrical engineering at the Wolverhampton and Staffordshire Technical College—The Clerk to the Governors, Education Office, North Street, Wolverhampton (June 9) A junior lecturer in the Department of Civil Engineering of the University of Liverpool—The Registrar, The University, Liverpool (June 10) A resident lecturer in hygiene at the Bangor Normal College—The Principal, Normal College, Bangor, North Wales (June 10) A head of the Department of Navigation at the Sir John Cass Technical Institute and Nautical School—The Principal, Sir John Cass Technical Institute, Jewry Street, E C 3 (June 10) Two veterinary surgeons under the South West Africa Administration—The

Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W C 2 (June 11) A lecturer in charge of the Clowne Mining Institute and a lecturer in electrical engineering at two mining schools—The Director of Education, County Education Office, Derby (June 11) A lecturer in electrical engineering mainly at the Heanor Mining and Technical School—The Director of Education, County Education Office, Derby (June 11) A lecturer in science at the Ebbw Vale Mining and Technical Institute—The Director of Mining Education, County Hall, Newport, Mon (June 12) A lecturer in geography at Birkbeck College—The Secretary, Birkbeck College, Breams Buildings, Fetter Lane, E C 4 (June 13) A Paterson Research scholar in the Cardiographic Department of London Hospital—The House Governor, London Hospital, E 1 (June 14) A junior lecturer in geography in the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W C 2 (June 14) A warden of the County Farm Institute, Moulton, and assistant county agricultural organiser, also a junior agricultural assistant, each under the Northamptonshire County Council—The Secretary for Education, County Education Offices, Northampton (June 14) A glass blower in the National Research Laboratories of Canada—The Secretary-Treasurer, National Research Council, Ottawa, Canada A Head of the Building Trades Department of the Bury Municipal Technical College, and a teacher of handicraft (woodwork and metal work) in the Bury Municipal Secondary School and Junior Technical School (jointly)—The Director of Education, Education Offices Moss Lane, Bury A teacher of electrical engineering at the Watford Technical School—The Principal, Technical School, Watford A research assistant at the Liverpool School of Tropical Medicine—The Hon Dean, School of Tropical Medicine, Pembroke Place, Liverpool An assistant to the adviser in economics at the Harper Adams Agricultural College—The Principal, Harper Adams Agricultural College, Newport, Salop Two assistant entomologists under the Division of Economic Entomology of the Commonwealth of Australia Council for Scientific and Industrial Research—F L McDougall, Australia House, Strand, W C 2

ERRATUM—The name of the author of the paper on "The Bavenda" delivered at the Royal Anthropological Institute on May 13, to which reference is made in NATURE of May 24, p 789, is H A Stayt, and not H A Stuyt, as printed

Our Astronomical Column

The Lowell Planet—It is announced from the Lowell Observatory that the name Pluto has been adopted for this planet

The assumption that the image found on a plate taken at Uccle Observatory, Belgium, on Jan 27, 1927, belongs to the planet enables fairly trustworthy elements to be deduced The first of the following orbits is by Prof Banachiewicz (*U A I Circ* 282), the second by Dr A C D Crommelin (*B A A Circ* 93) both are for the equinox of 1930 0

T	1984 Oct	1984 Dec 5 4 U T
ω	108° 56′	106° 45′ 40 0″
Ω	109 22	109 21 23 6
i	17 12	17 5 34 5
ϕ	17 19	16 41 49 7
log a	1 6110	1 6158060
log q	1 4576	1 4687050
Period	260 9 y	265 2828 y

Both orbits place the perihelion point slightly inside Neptune's orbit This is the first known instance (apart from the minor planets) of the orbits of two planets overlapping, the two orbits are separated by about 4 units, owing to the high mutual inclinations It will be seen that according to these orbits the planet will be steadily growing brighter for the next 54 years, and will be brighter than at present for 108 years

It is of interest to give for comparison the orbit predicted by Prof P Lowell in his memoir published in 1915, p 105, and reduced here to the equinox of 1930 longitude of perihelion (that is $\omega + \Omega$), 205°, i, 10° (estimated), ϕ, 11° 39′; log a, 1 6335; log q, 1 5355, Period, 282 years, T, 1991 March It will be seen that there is good accord both in the shape and position of the orbit and in the planet's place in it

Lowell did not give a prediction of Ω, but Prof W. H. Pickering in 1919 predicted Ω as 100°, i as 15°, both quite good approximations.

Large Fireball—A large fireball was observed on May 16 at 9 h 14 m P M by Mr R Skelton from Washington Station, Workington It appeared to be as bright as the full moon and it exhibited an orange colour It was first seen in the south south west, travelling to west south west at altitudes from about 23° to 13° The commencement of the flight was not witnessed, but the visible portion occupied about four seconds When it came into view it showed a pear shaped head which left a trail of bright sparks, no sound was heard and there were no stars visible to help in locating the path accurately The brilliant object was also noticed by a boy at Seaton From this place it was first seen in the south at about 25° altitude, and it passed across a window in its journey to south west, where it glided behind trees, the tops of which are about 20° high It was described as emitting a white light and shedding bright fragments as it traversed its course

Tercentenary of Kepler's Death—The tercentenary occurs this year of the death of Johann Kepler, and the May number of the *Scientific Monthly* contains an interesting review of Kepler's work by Prof Florian Cajori of the University of California Many of Kepler's original diagrams are reproduced, and we are reminded how unwearying was his search for harmonies connecting the planetary distances and periods His success in deducing the three famous laws is well known, but there were very many other researches, notably the attempt to connect the spheres described on the planetary orbits with the five regular solids The diagram in which the elliptical orbit of Mars was drawn for the first time is reproduced from "Astronomia Nova" The orbit is surmounted by a symbolical figure of Victory in a chariot

We see how study of Tycho's beautiful series of observations led Kepler to seek for a much closer accord between theory and observation than that which he deemed satisfactory in his early researches

Research Items.

Heredity of Polydactyly in Man—An analysis of certain family trees showing polydactyly has been made by O Koehler (*Biolog Zentralbl*, p 705, 1929) He finds that, combining the total numbers of occurrences in the various families concerned, the abnormality has occurred 230 times in men and 188 in women But this result, indicating that men are more subject to polydactyly, is due to the large numbers of males included in the older cases, and is contrary to Snyder's opinion Whatever the incidence of the abnormality may be, it would seem that it is equally heritable through male or female lines, for the numbers of fathers and mothers who passed on the defect were identical, 56 each Should further collections of data show that both sexes were equally capable of handing on the abnormality to their children, although it became manifest more often in males, this would support the view of the author

Variation in Chinese Students—A biometric study, analysing the physical measurements of a fairly representative group of Chinese students, has been made by Ju chi Li (*Peking Soc Nat Hist Bull*, vol 4, p 93, 1930) The data consist largely of physical measurements of male gymnasium students aged between twenty and twenty five and comprise broad aspects, such as height, weight, width, and thickness It was found that the student from northern China was decidedly taller in stature, thicker in chest capacity and heavier in weight On the other hand, the southern Chinese had a slightly longer leg in relation to the total height, and proportionately slightly wider shoulders On the whole, however, the northern type blends so gradually into the southern that it is scarcely justifiable to separate them on geographical grounds, except for such comparisons as are given in this paper Within the individual body various correlations, more or less close, were found, width, for example, depending upon height, and girth upon width Taken separately, the thickness of a person as measured by girth has the highest net correlation, height comes next, and width last So that height ought not to be taken as the sole weight index, a combination of height and girth giving a much closer correlation with body weight

Delayed Development of Embryonic Young in Martens—One of the interesting points noted by F G Ashbrook and K B Hanson in the course of observations upon the normal breeding season and gestation period of martens (*Martes americana*), was that the embryo showed marked delay in development (U S Dept Agr, *Circular* No 10, 1930) Such a delay is unusual, but is familiar in the case of roe deer in Great Britain Martens were observed to mate in midsummer (July and August) On Sept 4 all females were isolated from the males, but the young were not born until April of the following year Although it could not be determined to which of several matings conception was due, the gestation period ranged from 259 to 275 days or from 8½ to 9 months, a period excessively long compared with that of related animals of similar size and similar development at birth Positive evidence of delayed embryonic development is suggested by the observation that female martens trapped and killed in the wild have not shown macroscopic signs of pregnancy until late in winter

Sea Trout of South Uist—Mr G Herbert Nall in his paper, "Sea Trout of South Uist The Howmore, Kildonan, and Loch a Bharp Districts Part 2" (Fishery Board for Scotland, *Salmon Fisheries*, 1929, No 4), supplements his first paper of July 1928 (Fisheries, Scotland, *Salmon Fish*, 1928, 7) Most of the former conclusions are here confirmed and the tables are brought up to date The South Uist sea trout differ from the mainland types in their rapid growth rate, shortness of life and consequently few spawning periods The author again shows that there is no genuine spring run analogous to that of spring salmon, the fishes having almost all wintered in the loch or spent the greater part of the winter there There is no sign of any definite movement from sea to fresh water in February or March, although occasional visits to brackish water may account for the good condition of some of them, and there may be a small interchange throughout the winter between small shoals of fishes from the coast and those from fresh water These sea trout do not remain in fresh water until the following autumn, but have returned to the sea by May Of the marked fish only about 3 4 per cent were recaptured, mostly by the commercial nets

Axial Gradients—Dr Silvio Ranzi in his paper "Embriogenesi e gradienti assiali" (*Memorie della Pont Accademia delle Scienze—i Nuovi lincei*, Series 2, vol 12, 1929) discusses the question of the axial gradients of Child whether they truly exist in the course of embryonic development and regulate the growth, or whether they are the results of the unfolding of the embryo itself He concludes after examining the evidence of many workers in this field that this last solution is probably right, especially in vertebrates, annelids and cœlenterates which have a cephalo caudal or oro aboral axis, and, further, that the facts relating to differential susceptibility to toxic agents may be explained by the greater susceptibility of any organ at its most complex development Dr Ranzi's own observations have been made on the Cephalopoda, especially with regard to differential susceptibility, and he finds that the more complex the organ, the greater the susceptibility to toxic agents and the more easily and deeply are they inhibited He failed to demonstrate in the Cephalopoda the presence of axial gradients in the susceptibility of the blastoderm to toxic agents This paper reviews and criticises the work of various specialists on different groups of animals, ranging from planarians and cœlenterates to vertebrates The general conclusions are (*a*) that in the embryo permeability and susceptibility are greater in those parts which are most complex and are the centres of highest metabolism, but this is limited to the period of development of these parts, and (*b*) with regard to the importance of the principal axial gradients in embryonic development, the principal gradient must be retained as an apparent result of the processes of development according to an axis (vertebrates, annelids, cœlenterates), for along this axis are centres of metabolism, the highest being usually anterior However, the author is of the opinion that the metabolism does not increase or decrease gradually along the axis, but varies from time to time

Tertiary Molluscan Fauna of Waiheke Island, New Zealand—Early in 1927 a Tertiary deposit was discovered at Oneroa, Waiheke Island, near Auckland, New Zealand Collections of the contained molluscan fauna were made and the results are now detailed in a joint paper by A W B. Powell and J A. Bartram (*Trans N Z Inst*, vol 60) The beds seem to have accumulated in small pocket-like hollows worn in the underlying Trias-Jura Greywacke terrain prior to Tertiary submergence. Owing to the large percentage of new species accurate correlation

of these beds with fossiliferous horizons in other parts of New Zealand is very difficult, but the authors give reasons for considering them to be the equivalent of the Hutchinsonian stage of the Upper Oligocene. The fauna is decidedly littoral, or shallow water in character, two species of *Cominella* furnishing the most characteristic members. So far, 78 species have been found, of which five have been referred to recent forms and some 44 described as new. The seventeen plates, if not exactly artistic, give 109 sufficiently efficient figures which would have been more acceptable had the actual sizes of the originals been indicated beside them in some customary manner.

Duration of Eocene Time.—W. H. Bradley describes the varved sediments of the Green River formation (middle Eocene) of Colorado, Utah, and Wyoming in *Prof. Paper* 158 E of the U.S. Geol. Survey. The formation is a series of lake deposits averaging 2000 ft. in thickness. Many of the beds of marlstone, oil shale, and fine grained sandstone are varved, the dominant type being a pair of laminæ, one of which is markedly richer in organic matter than the other. The average thickness of the varves is about 0·18 mm., the range being from 0·014 mm. to 9·8 mm. The interpretation of the laminæ as varves is tested by analogy with modern lake deposits and by calculation of the annual thickness to be expected as judged from the data of present day stream loads. The Green River epoch is estimated to have lasted between five and eight million years. From this and an estimate of the rate of accumulation of the fluviatile deposits above and below the Green River formation the duration of the whole Eocene period is calculated to be between thirteen and thirty three million years. This result is of the same order as that deduced from age determinations of radioactive minerals, but is entirely independent of them. Three cycles of greater length are suggested by fairly regular recurrences of thicknesses and characters: (*a*) averaging a little less than twelve years, probably corresponding to the sunspot cycle; (*b*) about fifty years; and (*c*) about 21,600 years, suggesting the average period resulting from changes of eccentricity in the earth's orbit and the cycle of the precession of the equinoxes.

Aeroplane Survey in Canada.—The use of the aeroplane for transport and reconnaissance in the North West Territories of Canada has rapidly pushed northward for several hundred miles the area capable of development. During the last two summer extensive flights have been made in the Keewatin district to the west of Hudson Bay and in the Mackenzie district. Much preliminary prospecting of the ground has been done in this way. It is claimed that by a study of the country and especially by 'vertical' photographs examined stereoscopically the ground can be classed as promising or unpromising for more detailed investigation. The methods and routes are described in general terms in a pamphlet published by the Department of the Interior entitled "Preliminary Report on the Aerial Mineral Exploration of Northern Canada." Although the Keewatin area was found to be, on the whole, unpromising as regards minerals, a great deal of useful topographical information was obtained.

Settlement in Kenya.—The Agricultural Census of Kenya Colony (Tenth Annual Report, 1929) gives a statistical record of the progress of European settlement. The area occupied by Europeans reached about five million acres, showing an increase over that of the previous year of a little more than two per cent. The number of occupiers rose to 2035, and a further small addition gives a total of 2882 as the number of Europeans, including occupiers engaged on agricultural holdings. The numbers increase slowly and the rate has fallen from 10·37 per cent in 1924 to 3·25 per cent in 1929. Drought during the last two years is no doubt partly responsible. Nevertheless, the cultivated area of the occupied land continues to increase and is now more than eleven per cent. Maize continues to be the principal crop, but wheat has grown in importance. Sisal, hemp, and coffee promise well. A revival in the production of sugar is expected.

An Ice-Telemeter.—The necessity of recording the distribution of ice in waters frequented by vessels of commerce has led Prof. M. Kamienski to invent a simple instrument which he calls an ice telemeter, and which is designed to afford a ready means of measuring the distance of floating ice from the observer. The instrument and its use are described in *Wiadomosci Matematyczne*, Vol. 32, and Report No. 8 of the Astronomical Observatory of Warsaw University. The instrument is a kind of sight rule about half a metre in length. A movable scale at one end is aimed on the ice and the apparent horizon or a distant seacoast. The distance of the ice can then be read on the scale. Experiments over known distances have shown that the telemeter is not absolutely accurate, but near enough to accuracy for the purpose for which it is designed. It is intended for use in light ships and lighthouses of the Polish waters of the Baltic. The theory of the instrument is explained, but only a short summary of the paper is in English; the text is in Polish.

Soil Corrosion.—Corrosion, particularly of the ferrous metals, presents a serious industrial and economic problem, and hitherto the available remedies have been quite impractical. An illustrated article by H. W. Hough entitled "Significant Developments regarding Soil Corrosion" has recently appeared in *The Scientific Monthly*, Feb. 1930, vol. 30, from which it is evident that the study of the subject has advanced materially. The electro chemical theory of corrosion appears to be generally accepted, the rate at which hydrogen is evolved from the surface of the metal being actually proportional to the rate of corrosion. A method of soil corrosion surveys has been developed, in which soil samples are taken at intervals over the country through which a pipe line is to be laid. A topographical survey is also made, the amount of moisture, slope, and vegetation, and any local factors being taken into consideration. From a correlation of these data with the analyses of the various soil samples and their pH values, the degree of corrosive action in each district can be determined. The results obtained from such surveys agreed closely with those of some direct experiments carried out by the U.S. Bureau of Standards in which various metals, both treated with different paints and unprotected, were buried in different types of soil for two or four year periods. No one type of metal proved superior to all others in every type of soil, but it is clear that saving could be effected by a certain selection with regard to soil conditions. The inherent characteristics of the soil, however, are the dominating factors influencing corrosion.

Dependence of Raman Scattering on Frequency.—An analogy between the scattering of light without change in wave-length, and the modified scattering which constitutes the Raman effect, which is in sharp contrast to the general dissimilarity of these two processes, is given by Prof. Ornstein and J. Rekveld in the *Zeitschrift für Physik* for April 24 (p. 593). Quantitative intensity measurements were made on the Raman satellites produced by carbon tetra-

chloride on three strong blue and green lines of the mercury arc (λλ4047, 4358, and 5461) After allowing for the difference in intensity of the exciting lines, it was found that the intensity of a Raman line produced by a definite change in the molecule of carbon tetrachloride was proportional to the fourth power of the frequency of the exciting light, which is the same as Rayleigh's law for unmodified scattering The measurements were not sufficiently exact to decide if the correct frequency to be considered was that of the exciting radiation, or that of the light which had suffered a change in wave length in the scattering process

Single Mirror Interference Fringes with X-Rays —The issue of *Die Naturwissenschaften* for April 18 contains a note by W Linnik, of the State Optical Institute of Leningrad, on the interference of X rays in a Lloyd single mirror apparatus A glass reflecting surface was used, as for the usual optical experiment, but the short wave length of the X rays made it essential to work with a slit source of very small width, and to place it unusually close to the plane of the mirror Details of the experiment are not given, but it is stated that the slit used was only 0 1 μ wide, and that it was 2 2 μ from the mirror Fringes of excellent definition were obtained with a spacing of 5 μ on a photographic plate at a distance of 15 cm from the slit, from which the wave length of the $K\alpha$ radiation of copper has been calculated to be 1 56 ± 0 03 A, Siegbahn's value for this being 1 54 A

The Kata-Thermometer —The applications of this instrument, invented by Prof Leonard Hill, as well as full directions for its use, are set forth in a new pamphlet issued by the manufacturers, Messrs James J Hicks, Hatton Garden, E C 1 The kata thermometer has already proved itself to be the simplest and most useful means for checking the efficiency of ventilating systems and fully deserves its title of 'comfort meter and evaporimeter' The pamphlet now contains a chart from which wind velocity may be quickly derived once the reading of the dry kata thermometer is determined Though absolute standardisation in manufacture is impossible, each instrument is turned out with its own factor, thus rendering calibration by the purchaser unnecessary

Mechanism of Reactions —In a paper in the January number of the *Journal of Physical Chemistry*, by P Robinson, the question of the mechanism of reactions is examined from the point of view of a rule proposed by the author This states that in an isothermal system, where several reactions are possible, that reaction takes place first for which the products have the highest entropy The rule is considered for two typical systems, namely, the sulphur system and the water system, with steam, water, and ice as the possible phases In the latter case it is argued that if steam is brought into contact with excess of ice below the melting point, liquid water is formed before ice, although the reaction to form ice is so rapid that the intermediate liquid phase cannot be observed It is shown that two other rules which have been proposed do not agree with the facts in the case of some transitions in the two systems studied These are Ostwald's rule, according to which that reaction takes place first, the products of which are least stable, and Tantzov's rule, according to which that reaction takes place first which involves the minimum change of entropy The first does not hold when gaseous sulphur above the transition temperature passes directly into monoclinic sulphur without going to the rhombic form, and the second is in contradistinction to the fact that rhombic sulphur below the transition temperature passes directly into vapour without going through the monoclinic form These exceptions are, however, to be expected on Robinson's rule

Dissociation Constant of Water —The value of the dissociation constant of water, $K_w = [H^{\cdot}][OH']$, has been found by the conductivity of pure water, hydrolysis, and the e m f of cells The value found by the first method by Kohlrausch gave $1\ 04 \times 10^{-14}$ at 25°, and this has usually been considered the most trustworthy figure, although other values, such as $1\ 005 \times 10^{-14}$ found by Lewis and Randall by other methods, have more recently been put forward In the March number of the *Journal of the American Chemical Society*, R F Newton and M G Bolinger describe some experiments on the e m f of a cell containing mercurous bromide and mercuric oxide from which they have calculated the value of K_w The result obtained was $1\ 02 \times 10^{-14}$, from which it appears that the value of Kohlrausch is sensibly correct and that the newer values are somewhat too small

Reduction of Carbon Monoxide —Sabatier and Senderens in 1902 showed that a mixture of carbon monoxide and hydrogen when passed over reduced nickel at temperatures above 180° was reduced, with the formation of methane $CO + 3H_2 = CH_4 + H_2O$ Further investigations of the reaction showed that liquid hydrocarbons were also formed in the reaction In three papers in vol 12 of the *Scientific Papers* of the Institute of Physical and Chemical Research, Tokyo, published in February, S Kodama has given a summary of the literature on the subject and has described a number of important experiments on the reduction at normal pressure Various catalysts were used, particular attention being directed to the catalytic decomposition of the monoxide with deposition of carbon With nickel this decomposition did not occur, but it was found with other catalysts

High Tension Testing —Although our knowledge of the behaviour of aircraft during thunderstorms has been increased by reports on cases where they have been struck by lightning, yet there are many technical questions involved which are still difficult to answer The hot exhaust from the engines is doubtless a likely path for the flash The ignition system also may be broken down by the flash and the collapse or building up of a strong electrostatic field in the neighbourhood seriously adds to the fire risk In a paper by A O Austin, engineer to the Ohio Insulator Company, read to the High Tension Congress held recently in Paris, an abstract of which appears in *Engineering* for April 4, an account is given of a novel equipment for open air experiments at electric pressures up to three million volts Several years ago the company recognised that the cost of indoor tests on models at the necessary high pressures would be prohibitive The laboratories have been built to enclose a courtyard one side of which is open and faces the testing ground, which is 1000 feet long and 400 feet wide The high tension equipment consists of three 750 kilovolt transformers of identical types which can be connected in series The bushing of the highest voltage transformer is fifty feet above the ground They have been operated when the crest voltage is well over three million volts It was found that at pressures greater than two million volts it was very difficult to prevent 'flash-overs' from the mains For the artificial lightning tests the transformers charge a very large air condenser By distance control the voltage of the generators is gradually increased until the flash-over at the impulse gap takes place

The Tatem Laboratories at University College, Cardiff

University College, Cardiff, was honoured on May 21 by a visit from H R H the Prince of Wales, Chancellor of the University of Wales, for the purpose of opening the new laboratories of chemistry and physics and inspecting the Advisory and Research Department of Agriculture and the Institute of Preventive Medicine of the Welsh National School of Medicine

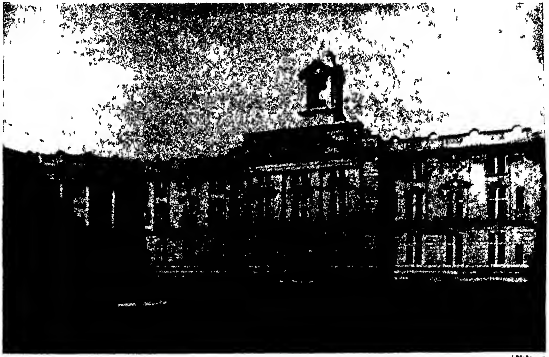
The laboratories of chemistry and physics constitute the north wing of the College buildings in Cathays Park, Cardiff, the civic quarter of the city, which is exclusively devoted to public buildings designed to form an harmonious ensemble Long projected and long delayed by the great rise in the costs of building since the War, these laboratories are the culmination of an effort of local patriotism which the depressed state of industry in South Wales has made trebly difficult Nevertheless, they are only an instalment of the completed plan The arts and administrative sections of the College have been housed upon the Cathays Park site since 1909, but it yet remains to erect the south wing, to accommodate botany, zoology, and geology, which are still in their old quarters in Newport Road, as well as to put up the Great Hall of the College on the fourth side of the quadrangle

The new wing which has been formally opened by the Prince, was designed by Mr W D Caroë, the architect of the main buildings In it, chemistry and physics are accommodated together in close association and in a manner really worthy of the intellectual and industrial importance of modern studies in these subjects

The Department of Chemistry occupies the basement and the first and second floors The first floor comprises a qualitative laboratory for 102 students, a quantitative laboratory for 60 students, two organic laboratories for 60 and 30 students respectively, three balance rooms, combustion room, an electro chemical laboratory, store and service rooms, a library, and staff private rooms

On the second floor are two physico chemical laboratories, a dark room, three research laboratories, a workshop, and two lecturers' rooms The basement, approached by a cart way from the street, provides a store for acids, solvents, and heavy chemicals, with communication by lift to the laboratories and to further capacious store rooms on the upper floors

At the present moment the building of the chemical lecture theatres, preparation rooms, and museum is not being proceeded with, although the foundations of the whole block have been laid



Photo] [Blakeman.

FIG 1 —Physics and Chemistry Laboratories

Special attention has been given to efficient ventilation Each series of fume chambers is independently exhausted by fans to the roof, while the rooms are fitted with a specially designed system of air flues, also connected to a large exhaust fan on the roof Accessibility of water, gas, electric, and drainage services has been secured wherever possible In the larger laboratories, ridge and furrow top lights have been employed, ensuring exclusively north lighting The benches in the large laboratories have been arranged on the island principle and their low superstructures facilitate supervision of large classes

The physics accommodation occupies the whole of the ground floor, with an additional six rooms on a mezzanine floor As the new laboratories communicate directly with the ground and first floors of the Viriamu Jones Memorial Research Laboratories, the Physics Department is now, after many years, once more housed under one roof, with, obviously, very great advantage to all concerned

As in the case of chemistry, the present accommoda

tion represents only a stage in the complete scheme Another wing is to be provided, with a large lecture room, workshop, additional research accommodation, and small laboratories for special research The present building contains a small lecture room and a temporary workshop, which is, however, very well equipped Other small rooms, originally planned for special experimental work, have had to be used for routine work by honours students, as a result of the large increase of the honours school

The greater part of the physics for intermediate and final degree students is accommodated in three large, well lighted rooms, each approximately 30 ft by 50 ft

Photo] FIG 2 —Institute of Preventive Medicine [Blakeman.

Except in the case of the junior laboratory, large, fixed benches in the centres of the rooms have been entirely avoided The essential gas and electric services are led to a series of light posts, about 4 ft high, around which working tables are grouped as required This arrangement, with its obvious flexibility, has proved very satisfactory in practice

The senior electrical work is provided for by two fairly large electrical laboratories These were originally intended to be reserved for final and honours students respectively, but a certain amount of overflow has been inevitable Four darkened rooms are provided for optical experiments and there are smaller rooms for experiments which cannot conveniently be carried out in the general laboratories

Electrically, the laboratories are very well supplied with lighting and power points for 200 volt D C, while 200 volt, 50 cycle alternating current is available also at a number of points The galvanometer lamps are supplied with 12 volt A C, stepped down from the municipal A C supply Steady current for experimental work is derived from a battery of seventy 250 ampere hour accumulators This battery feeds, through a terminal board of special design, 28 points and sub-switchboards in the teaching and research laboratories Any voltage from 10 volts to 140 volts, in steps of 10 volts, can be supplied to any point Large currents over a wide range of voltages can be supplied through the same board, from either a large or a small motor generator, installed in the switchboard room

The building of these laboratories on such a scale was made possible by the generosity of a number of public men in South Wales The chief donors were Lord Glanely, sometime president of the College, and his successor in that office, Sir David Llewellyn, Bart

His Royal Highness was received by Lord Treowen, president of the College, Principal J F Rees, The Hon W N Bruce, Pro Chancellor of the University of Wales, and others He inspected the statues of His Majesty the King and of himself as Chancellors of the University, niched in the College facade, which had been unveiled by Lord Glanely prior to His Royal Highness' arrival Lord Treowen then addressed the Prince, giving a short history of the development of the College and of the progress of its Building Fund Appeal In the course of his response the Prince said "At one time it was generally considered that the chief object of university training was the preparation of students for academic careers, but nowadays the importance of the relation between science and industry is more clearly realised, and we know how valuable a contribution scientific training makes to our commercial and industrial welfare Close co operation between leaders in academic life and the controllers of great business concerns is in the best interests of the country, and from its universities in future will go forth not only the teachers of the generations to come but also—and this is just as essential — young men well equipped by their training to maintain our vital supremacy in commerce and industry"

Lord Glanely then announced that he had decided to increase his benefaction by the sum of £20,000, which would wipe out the debt on the existing building and provide a capital sum for maintenance, while on behalf of himself and Sir William Reardon Smith, he also announced the foundation of three new scholarships The Prince then announced a further donation from Mr Dan Radcliffe, treasurer of the College, of another scholarship and a capital sum of £5000

Finally, the architect, Mr W D Caroë, handed the key to His Royal Highness, who declared the building open Prof H R Robinson (physics) and Prof W J Jones (chemistry) were then presented and accompanied the Prince in his inspection of the Laboratories

Afterwards, a short visit was paid to the Advisory and Research Department of Agriculture, a block at the south end of the main facade of the College, which also owes its existence to the great generosity of Lord Glanely Here there are three floors, containing the offices of the advisors in veterinary science, agricultural botany, and agricultural zoology respectively, together with a large joint Museum and three laboratories, as yet unfurnished, which it is intended to devote to research in problems ancillary to agriculture

In the afternoon the Prince paid a visit to the Institute of Preventive Medicine of the Welsh National School of Medicine in The Parade The foundation

stone of this Institute was laid by His Royal Highness in 1921, on the occasion of his installation as Chancellor of the University of Wales

The present visit enabled Sir William James Thomas, Bart, the donor of the Institute, to hand over the title deeds of the building to the University College of South Wales and Monmouthshire

The Institute comprises four storeys and a basement, and contains, beginning at the top floor, first the Department of Tuberculosis, supervised by Prof Lyle Cummins, the David Davies professor of tuberculosis in the School of Medicine and Director of Research to the King Edward VII Welsh National Memorial (Tuberculosis) Association On the second floor is the Department of Pathology, at present in charge of Dr J B Duguid, the chair being vacant The first floor is devoted to the Department of Preventive Medicine, in charge of the Mansel Talbot professor, Dr E L Collis, who is also Director of the Institute Lastly, the ground floor is occupied by the joint City and County Laboratory of Public Health This is a most valuable feature of the organisation, since it is housed here alongside of the Department of Preventive Medicine and the materials, equipment, and personnel of the public laboratory are available as part of the organisation of the teaching department

The Research Scheme of the Institute of Brewing

If we except the research work carried out with the object of elucidating medical problems, there are no other investigations of so comprehensive a character as those concerned with malting and brewing The problems here presented are connected with biology chemistry, physics, and engineering, and the knowledge gained is of service, not only in the branches of technology for which they are undertaken, but they also find application in many other directions To take but one instance, the study of fermentation has produced results of incalculable benefit to mankind in general, for cannot we trace our present knowledge of zymotic disease to the researches of Pasteur on wine, beer, and vinegar? It is therefore of the highest importance to review the knowledge that is being collected by those who are working under the Research Scheme of the Institute of Brewing, an outline of which is given in the Memorandum for 1930 which was issued a short time ago

An important part of the researches on barley is concerned with the production of new varieties and the Institute is, in this connexion, closely associated with the National Institute of Agricultural Botany, Cambridge, as well as with the Rothamsted Experimental Station, Harpenden and Woburn, nor must we omit to mention the valuable work on barley breeding carried out by Dr E S Beaven The Institute is collaborating with the research staff of the Distillers' Company in tracing the changes that occur in the protein and carbohydrate constituents during the development of the grain and during the malting process The metabolism of the proteins of barley in the germination process is being studied at Rothamsted by Dr R L Bishop, whose results are of far reaching importance and interest to both pure and applied science Manuring experiments on barley and on hops are being carried out and the crops submitted to small scale brewing trials in the laboratory The breeding of new varieties of hops has for many years been carried out by Prof E S Salmon of Wye College Some of the new varieties obtained have been put through brewing trials by well known brewery firms

Methods for determining the brewing and antiseptic properties of hops have been devised by Mr A Chaston Chapman (chairman of the Research Committee), by Messrs Ford and Tait, Prof F L Pyman, Dr T K Walker, and Mr J J Hastings The diseases to which hops are subject are being studied by Prof Salmon and his colleagues Mr A H Burgess is engaged in experiments on the drying of hops, and he has specially studied the processes in vogue at Czechoslovakia

Researches on yeast were commenced at the Imperial College of Science and Technology by the late Prof S B Schryver This work, as well as that on the nitrogenous constituents of wort, which was interrupted by the untimely death of Prof Schryver last year, is being continued by other investigators

The existing methods of estimating starch in barley and in malt are being revised by Prof A R Ling and new methods are being devised This work, it is hoped, will be published very soon Prof Ling is also working on the carbohydrates of barley and malt other than starch

This activity in research, under the able direction of Mr H Lloyd Hind, must commend itself alike to all scientific workers

University and Educational Intelligence

CAMBRIDGE Mr M H A Newman and Mr A S Besicovitch have been reappointed University lecturers in mathematics, Mr W M Smart, of Trinity, and Mr A F Ingham of Trinity, have been appointed University lecturers in mathematics Mr I G Bedford, of Sidney Sussex, has been reappointed University lecturer in physics, and Mr J D Bernal University lecturer in structural crystallography

Mr E B Worthington, of Gonville and Caius College has been elected to the Balfour Studentship

The Vice Chancellor has published a letter from the Universities Bureau of the British Empire in which it is stated that the executive committee of the Bureau has been asked by the Trustees of the Josefine and Eduard von Portheim Foundation to make grants to enable one or more graduates of universities of Great Britain and Ireland to take a post graduate course or undertake research in the University of Heidelberg Preference on the occasion of the first election will be given as between candidates of equal merit to a student proposing to work in mineralogy or crystallography in the Mineralogical Institute founded and directed by Prof V Goldschmidt

New regulations for the Economics Tripos will come into effect next year Under the new scheme, the first part of the Economics Tripos will become a one year course and the second part will, normally, take two years, although candidates coming from another Tripos in their third year will be allowed, if they wish, to take it in one year but with a reduced number of papers The objects of the change are to throw the emphasis more on the second part than it is at present, getting thereby a higher standard of advanced work, and to strengthen the political side by putting in a practically compulsory paper on the principles of politics

LONDON —The following appointments have been made Prof H R Robinson, since 1926 professor of physics at University College, Cardiff, to the University chair of physics tenable at East London College, Dr J W Munro, who has since 1926 been responsible for the control of the Imperial College Biological Field Station at Slough and for the direction there of a research for the Empire Marketing Board, to the University chair of entomology tenable at the

Imperial College (Royal College of Science), Prof P G H Boswell, since 1917 Herdman professor of geology in the University of Liverpool, to the University chair of geology tenable at the Imperial College (Royal College of Science)

The following doctorates have been conferred *D Sc in chemical technology* Mr D M Newitt (Imperial College—Royal College of Science), Mr D T A Townend (Imperial College—Royal College of Science and East London College), *D Sc in chemistry* Mr M Q Khuda (Imperial College—Royal College of Science), *D Sc in psychology* Mr A S J M Huggett (St Thomas's Hospital Medical School), *D Sc in mathematics* Mr R C J Howland

MANCHESTER —Prof J M F Drummond, Regius professor of botany in the University of Glasgow, has been appointed Harrison professor of botany and director of the botanical laboratories in the University on the retirement of Prof F E Weiss Prof Drummond was educated at King's College, London, and at Gonville and Caius College, Cambridge He gained a first class in Part II of the Natural Science Tripos in 1904 and was elected to the Frank Smart research studentship, which he held for two years while engaged on research on photosynthesis with Dr F F Blackman He was appointed as lecturer in botany at Armstrong College, Newcastle upon Tyne, in 1906, and became senior lecturer in plant physiology in the University of Glasgow in 1909 On the establishment in 1921 of the Scottish plant breeding station at Corstorphine, Midlothian he was appointed as its first director, and resigned in 1925 on appointment to the Regius chair of botany at Glasgow While Prof Drummond's botanical interests cover a wide range, his original investigations have been especially concerned with plant physiology and genetics The University already possesses at the Firs in Fallowfield experimental grounds which it is hoped Prof Drummond will be able to develop still further on lines useful to the promotion of horticulture and agriculture

Dr John Walton, lecturer in botany, has been appointed a senior lecturer as from September next

The Council has gratefully accepted the offer of the Manchester Medical Society to present to the University its medical library This library has been housed in the University since 1875, and for a number of years has been supported jointly by the Manchester Medical Society and the University Provision has been made for the members of the Manchester Medical Society to continue their use of the library, and the Society has undertaken to make an annual grant towards the cost of maintenance

At the celebration on May 23 of the jubilee of the University and the eightieth anniversary of the foundation of Owens College, the honorary degree of D Sc was conferred on Prof J Lorrain Smith, professor of pathology and dean of the faculty of medicine in the University of Edinburgh, and Prof A Smithells, director of the Salters' Institute of Industrial Chemistry, London

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THE Secretary of State for the Colonies will in June and July next award post graduate scholarships in agriculture and agricultural science tenable for from one to two years, and post graduate scholarships in veterinary science tenable for from one to four years The annual value of each scholarship will be £250 plus a certain allowance for expenses Application forms, etc, may be had from the Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S W 1, to whom the completed forms must be returned before June 15

Historic Natural Events

June 1, 1924 Floods—In consequence of heavy rains on the night of May 31–June 1, exceeding four inches in parts of Shropshire and Worcestershire, severe floods occurred in western England Worcester was flooded and the Three Counties' Agricultural Show had to be abandoned

June 2–4, 1666 Abnormal Audibility of Gunfire—On June 2 Pepys wrote "Into the Parke, and there we could hear the guns from the fleete most plainly" But the guns were not heard on the coast, and the yacht *Katherine*, which came into the Thames on that day, heard no firing On June 4 Pepys added "So walking through the Parke we saw hundreds of people listening at the Gravell pits, and to and again in the Parke to hear the guns, and I saw a letter, dated last night, from Strowd, Governor of Dover Castle, which says that the Prince (Rupert) come thither the night before with his fleete, but that the guns which we writ that we heard, it is only a mistake for thunder, and so far as to yesterday it is a miraculous thing that we all Friday and Saturday and yesterday, did hear everywhere most plainly the guns go off, and yet at Deale and Dover to last night they did not hear one word of a fight, nor think they heard one gun This, added to what I have set down before the other day about the *Katherine*, makes room for a great dispute in philosophy, how we should hear them and they not, the same wind that brought it to us being the same that should bring it to them but so it is" This is probably the first definite reference to the 'zone of silence' in the audibility of gunfire

June 4, 1783 Honey Dew—Under this date Gilbert White records ("Natural History of Selborne") "Vast honey dews this week My honeysuckles, which were one week the most sweet and lovely objects that eye could behold, became the next the most loathsome, being enveloped in a viscous substance, and loaded with black aphides or smother flies"

June 5, 1692 Heavy Rain—It is related that the capture of Namur on June 5, 1692, after a siege of only ten days, was largely due to heavy rains which prevented the English army from crossing the river and engaging the besieging French army

June 5, 1784 Thunderstorm—A violent thunderstorm is described in White's "Natural History of Selborne" It began about 2 15, moved from south to north, with convex pieces of ice three inches in circumference which did great damage to windows and tiles At the same time a torrent of rain flooded the meadows, the hollow lane towards Alton was so torn and disordered as not to be passable, rocks being removed that weighed two hundredweight

June 7, 1573 Hailstorm—Between 1 and 2 P M a violent hailstorm broke over Towcester in Northamptonshire, in which six houses were destroyed and fourteen others greatly damaged by floods The hail stones were square and six inches in circumference

June 7–8, 1111 Torrential Rain in Belgium—"On June 7, at the hour of nine, there broke above Robermont (near Liège) three of the blackest rain clouds, which broke very suddenly, so that all was washed away in the city of Liège, it carried off houses, men and women into the River Meuse And the next day, which was Sunday, there came great black clouds which broke over the great church" The lightning did a great deal of damage to the building, and killed a clerk who was reading from the pulpit, and a worshipper who was on his knees praying before the crucifix

June 7, 1692 Earthquake in Jamaica—Port Royal, then the capital of Jamaica, was destroyed by an

earthquake, 3000 lives being lost Three fourths of the buildings in the city and the ground they stood on sank entirely under water Large storehouses on the harbour side were afterwards found 24 48 feet below the sea level A tract of land round the town, about 100 acres in area, sank during the first shock and the sea immediately flowed in

June 7, 1922 Fata Morgana in Hungary — At Nagyhortobagy, Hungary, across a grassy plain with huts, hills, and a well in the distance, all the objects were elevated and in great unrest At several places water surfaces appeared in lively movement with waves moving from west to south west The huts and hills appeared above the water, and then disappeared from time to time A herd of horses driven to the well appeared to advance and then back, and the herdsman and his horse seemed to make an undulating movement, whereas in reality they stood near the well At the time the sky was one third covered with cumulus cloud, and a light wind was blowing from the north

Societies and Academies

LONDON

Royal Society, May 22 —**G H Parker** The ciliation of the Fallopian tubes In the rabbit, spermatozoa travel through the uterus by their own locomotory powers and ascend the Fallopian tube in the main by counter currents (the return flow from the ciliary currents) The eggs press on the ciliated surfaces of the Fallopian tube and descend through this tube chiefly by ciliary action peristalsis may also play a part In the turtle and pigeon the oviduct is lined with cilia most of which beat toward the exterior, but there is also a narrow longitudinal band of cilia which beat toward the ovary and thereby carry spermatozoa to that organ —**D Keilin** Cytochrome and intracellular oxidase Neither component c of cytochrome from yeast cells, a clear solution of deep red colour nor oxidase of heart muscle preparation will oxidise cystein The two together form a powerful catalytic system which can rapidly oxidise cystein The catalytic system thus reconstructed behaves like a true respiratory system of the cell **L E Bayliss, E Boyland, and A D Ritchie** The adductor mechanism of *Pecten* The slow part of the adductor can be isolated from the nervous system in a completely relaxed state in *P magellanicus*, stimulated electrically it gives twitches which can be fused to form tetanus Large tensions are developed In *P maximus* and *P opercularis* different nervous connexions make it difficult to isolate the muscle without some 'contracture', apart from this the muscles are similar to *P magellanicus* The state of contracture is a result of reflex excitation which survives isolation, but may be abolished by direct faradic stimulation Tensions in 'contracture' are much less than the maximum obtainable Reflex movements of intact animals suggest that for the most part the muscle is contracting tetanically The quick muscle with single induction shocks gives a rapid twitch that resembles normal reflex contraction —**H E Roaf** Visual acuity in light of different colours Definition with short wave lengths is less accurate than with medium or long wave lengths That relative intensities, chromatic aberrations, and scatterings of lights can be the whole cause of the observed poorness of visual acuity with short wave lengths seems improbable More likely a lesser density of specific receptors per unit of retinal area is involved With colour filters in front of certain receptors, 'blue' may stimulate only some of them, whilst longer wave lengths can stimulate a larger number per unit area, or the difference might be due to a number of rods being linked to a single ganglion cell, whilst there may be a separate ganglion cell for each cone Evidence is given that the receptors limited to reception of short wave length stimuli are the rods —**Sir Charles Sherrington and J C Eccles** Numbers and contraction values of individual motor units examined in some muscles of the limb Contraction tension for the average motor unit was examined by dividing tension of maximal contraction into number of nerve fibres in the muscle nerve Figures obtained were *gast med*, 30 1 gm *soleus*, 9 9, *semitend*, 5 5, *ext l dig*, 8 6 In all nerves examined analysis of fibre sizes shows two peaks of numerical preponderance, centred on two fibre sizes rather far apart, thus *gast med* 15 μ and 6 μ as measured Of the group of efferent myelinate fibres entering the muscle, many exist several centimetres proximal to muscle, approaching the muscle additional myelinate fibres appear Afferent fibres examined exhibit increase in number as followed in nerve trunk before reaching muscle Approximate estimates of number of motor units composing type muscles are *gast med* 430, *ext l dig*, 330, *soleus*, 250

Royal Meteorological Society, May 21 —**Sir Gilbert T Walker** Seasonal foreshadowing Some applications of the tables of relationships given in previous studies of world weather The southern oscillation affects the winter temperatures of south west and north west Canada as well as the summer rainfall of South Africa and Australia, and the total correlation coefficients found are 0 71, 0 72, 0 72, and 0 79, these would seem to justify prediction in general terms in nearly half the years of a long series —**A C Best** Instruments for obtaining dry and wet bulb temperatures A modified form of the Casella type psychrometer is described in which the aspiration effected by a small electric motor, has the value of 5 metres per second as compared with 1 5 m per second in the usual instrument This psychrometer will run for about eight minutes in air having a relative humidity of 33 per cent before the wet bulb dries up The results of comparing the depressions given by these two psychrometers, two types of sling psychrometers and a Stevenson screen are given

PARIS

Academy of Sciences, April 14 —**Ernest Esclangon** The position of the celestial body at present supposed to be a trans Neptunian planet Application of a parallactic method to observations made at the Paris observatory —**André Blondel** Symmetrical alternators connected with an unsymmetrical network or line —**Léon Guillet and Jean Cournot** Remarks on cold hardening and the annealing of metals and alloys A discussion of two recent communications by Guichard, and by Claussmann and Billon —**F Gonnesslat** The position of the Lowell planet obtained with the photographic equatorial of the Observatory at Algiers —**P Pfeiffer** The operators of a complete system of linear and homogenous partial differential equations of the first order of an unknown function —**Radu Badesco** The distribution of the values of a holomorph or meromorph function —**Elie Cartan** The third fundamental theorem of Lie —**Nicolas Théodoresco** The determination of the velocities as a function of the vortices in the case of a fluid in two dimensions —**Basile Demtchenko** A method of calculation of surfaces of slipping —**P Dupin and M Teissie-Solier** Alternating vortices in non turbulent and in turbulent regime —**F Bordas and E Roelens** Alcoholometric corrections for temperatures below 0° C The range of temperature covered by the experiments was + 15° C to − 30° C —

J Dorfman The magnetic moment of the nucleus of the atom —L Andrieux The preparation of thallium by the electrolysis of its oxides Pure thallium can be prepared by electrolysing its oxides dissolved in boric anhydride (950° C), in alkaline borates (855° 880° C), or in mixtures of borates and fluorides of the alkali or alkaline earths (900° 950° C) —Marcel Chatelet Mixtures of vapours of iodine and of various solvents The absorption spectrum of the gases arising from the vaporisation at 90° C of a solution of iodine in benzene gives an absorption band which belongs neither to the vapour of iodine nor to that of benzene A molecular association is assumed to explain the results —René Dubrisay, René Arditti, and Charles Astier Some transformations produced by the phenomena of absorption —F Vlès and N Kyvelos The spectral properties of the benzoate as a function of the concentration of neutral salts —Jean Cournot The influence of the treatment of steels in solutions of complex phosphates with subsequent varnishing, on their electrical insulating properties —André Courty Tests of casting, under constant pressure, of aluminium and alpax The effects of temperature of the liquid metal, temperature of the mould, and time of heating before pouring were studied separately Jean Challansonnet The dilatometric analysis of some synthetic cast irons with nickel, vanadium, and nickel vanadium These alloys were prepared in a high frequency induction furnace with five metals, and contained 0 08 per cent silicon and only a trace of phosphorus Vanadium raises the temperature of graphite formation of a pure cast iron, it counteracts the graphitising effect of nickel, one part of vanadium annulling the effect of four parts of nickel —Pierre Urbain A quantitative method of spectrographic analysis The method described was designed to deal with quantities of gold of the order of 0 001-0 005 mgm and is based on the simultaneous electrolytic deposition on a carbon rod of the gold and a known quantity of silver This rod is used to obtain spark spectra, and the relative strengths of the silver and gold lines measured with a recording microphotometer —L Palfray and B Rothstein The 1 3 and 1 4 cyclohexanediols Constitution of the halogen derivatives —Jean Thibaud and F Dupré la Tour Study of the polymorphism of the crystals and the orientations of the fatty acids as a function of the temperature From a study of the X ray spectra it is concluded that the saturated fatty acids can be obtained in two principal well defined crystalline forms presenting important differences in their physical properties, especially in the refractive index - Henri Vincienne The structural relations between the Rochers de Léaz (Ain) and the Vieux Chateau d'Arcine (Haute Savoie) and the Vuache Conclusions on the tectonics of this chain —M Loeper, A Lemaire, and A Mougeot The function of the glycogen in the activity of the snail's heart —André Giberton The synthesis of fats in the presence of pancreas extracts —Georges Blanc and J Caminopetros The transmission of the variole of birds by mosquitoes

Rome

Royal National Academy of the Lincei, Feb 2 — Gino Fano Nets of linear complexes of the space S_5 — G Armellini The modern theory of the evolution of the stars Many data based on observation show that, during the first phase of their existence, stars are of great volume, very low density, and intense brightness. The latter diminishes slowly and continuously, and the density increases, whilst the effective temperature of the photosphere, measured spectrophotometrically, rises to a maximum and then begins to fall — C Somigliana The external gravitational field of the ellipsoidic geoid The determination of the lines of force in the field external to the ellipsoidic geoid by integration of the differential equations of these lines is difficult, since the potential function is not harmonic, so that neither Beltrami's ordinary theory of symmetrical potential functions for the case of the ellipsoid of rotation, nor Jacobi's theorem is applicable Various properties of the field may, however, be developed by comparatively simple calculations —U Cisotti Plane electrostatics —A Tonolo Intrinsic form of the equations of the equilibrium of elastic media (1) —R Cacciopolli A question of stability —S Cherubino Observations suggested by a theorem on real Abelian varieties — Rina Baldoni Systems of principal normals to a variety in its π_3 (2) —Pia Nalli Generalised derivations and classification of Riemannian spaces — M Brelot The notion of a point source of heat in a radiating plane in thermal equilibrium —J Geronimus A formula of Tchebycheff —N Théodoresco Steps in a theory of the functions of a complex variable in the general sense (1) —E Gugino The incipient motion of systems with reversible linkings —E Carafoli Theoretical considerations on 'flat spinning' (aerodynamics) — U Barbieri Astronomico geodetic station of Eremo di Cherasco (1) —A Quilico and M Freri A new method of formation of pyrrole blacks One of the most striking facts on which the analogy between phenol and pyrrole is based is the ease with which pyrrole and its homologues couple with diazo compounds This analogy is strengthened by the observation that addition of pyrrole to an alcoholic or glacial acetic acid solution of a diazonium salt, cooled and stirred, results in a very dark, reddish violet solution, which soon deposits a deep black powder resembling pyrrole blacks but, unlike these, almost insoluble in alkalis —R Masini The Rhætic in the Valle della Lima — G B Cacciamali Possible investigations in the subsoil of Lombardy — M Fenoglio Presence of nesquehonite in the serpentine of Viù in Val di Lanzo The possibility of a genetic connexion of the comparatively rare mineral, nesquehonite, with other hydrated magnesium carbonates is considered It is, however, regarded as more probable that nesquehonite is formed at the ordinary temperature and pressure, and that artinite and hydromagnesite are produced at somewhat higher temperature and pressure —G Mezzadroli and E Vareton Action of ultra violet rays on the germination of seeds and on the growth of plants Ultra violet rays of short wave lengths—less than 3000 A — exert a harmful influence on the germination of seeds and on the development of plants At short range, the total ultra violet rays emitted by a quartz mercury vapour lamp exhibit a similar injurious action, even when the exposure is of only brief duration If the seeds and plants are placed at an oblique distance of 50 cm from the lamp, short exposures of 1 5 minutes produce favourable effects, but more protracted exposures, unfavourable effects — M Comel Can strontium be fixed by the tissues? The results of experiments with hens and rats fail to indicate any appreciable fixation of strontium in the tissues

Washington, D C

National Academy of Sciences (*Proc*, Vol 16, No 1, Jan 15) —E S Castle The light-sensitive system as the basis of the photic responses of *Phycomyces* The relation of the 'light growth' response and the phototropic response is investigated by noting the variation of latent period, which is common to both effects, with change of duration of exposure The changes of each response are similar and it is concluded that they have the same functional basis —

H C Ramsperger and R C Tolman The rate of decomposition of nitrogen pentoxide at very low pressures A 45 litre flask was used and a pressure gauge depending on the change of capacitance of a condenser, one plate of which is attached to a mica diaphragm in contact with the gas the pressure of which is to be measured The rate of homogeneous decomposition is of the first order, but when glass tubing is introduced into the reaction vessel to increase the surface, there is a falling off of specific reaction rates —**James A Beattie** A new equation of state for fluids (4) An equation expressing the volume as an explicit function of the pressure and temperature —**George L Clark and Lucy W Pickett** Crystal structures of some derivatives of diphenyl X ray studies of diphenyl, dimesityl and *o* tolidine —**Oliver R Wulf** The temperature coefficient of the photo chemical formation of hydrogen chloride —**E L Nichols and Frances G Wick** Ozone in luminescence Several thermo luminescent substances activated by X rays or cathode rays after treatment with ozone, suffer diminution in brightness Activation by X rays is a reducing effect, when the reduced product is comparatively stable at room temperature but oxidises rapidly and spontaneously on heating, thermo luminescence occurs The effect of ozone is hence due to partial re oxidation —**Paul S Epstein** Geometrical optics in absorbing media A general discussion which has particular significance in the transmission of radio waves in the upper atmosphere —**Edwin H Hall** Recent progress in the dual theory of metallic conduction The numerical results, with recent data, of applying the theory to the relation between electrical conduction, thermal conduction, and Thomson and Peltier effects in eighteen metals, including two alloys —**F S C Northrop** Two contradictions in current physical theory and their resolution A theoretical examination, as a result of which a macroscopic atomic theory is proposed whereby the electrons and protons of the whole of Nature are surrounded by one large finite spherical macroscopic atom Among the consequences are that the universe is finite, there is a physical ether, a new geometry is required, the motion of the microscopic atoms in the macroscopic atom is absolute and the second law of thermodynamics cannot be valid for the whole of Nature —**H E White** Theoretical interpretation of hyper fine structure in singly ionised thallium, Tl II —**Theodore Lyman** The distribution of light intensity in a Fresnel diffraction pattern from a straight edge A diffraction system was illuminated by monochromatic light and intensities registered on a photographic plate measured by a photometer The agreement between theory and experiment are within the limits of error —**Frank Morley and Henry A Robinson** Note on range finding A mathematical discussion for obtaining the co ordinates of the source of sound —**Ernest W Brown** Applications of an expansion theorem to the development of the disturbing function —**Hillel Portisky** On certain polynomial and other approximations to analytic functions —**G A Miller** Groups which admit two thirds automorphisms —**Aristotle D Michal** Differential geometries of function space

Official Publications Received

BRITISH

Proceedings of the Royal Society Series A, Vol 127, No A805, May 7 Pp 239 479 (London Harrison and Sons Ltd) 8s

Annual Report of the Council of the Yorkshire Philosophical Society for the Year 1929, presented to the Annual Meeting, February 10th, 1930 Pp 48+13 (York)

Department of the Interior North West Territories and Yukon Branch Preliminary Report on the Aerial Mineral Exploration of Northern Canada By G H Blanchet. Pp. 92 (Ottawa F A Acland)

Proceedings of the Royal Society of Edinburgh, Session 1929–1930 Vol 50, Part 2, No 8 A Case of Intersexuality in *Bos indicus* with a Theory of the Significance of the Genetic Male Intersex By D R R Burt Pp 113 129+9 plates 2s Vol 50 Part 2 No 9 Studies in Translocation No 1 Movement of Food materials in the Swedish Turnip By John Caldwell Pp 130 141+1 plate 1s 6d Vol 50 Part 2 No 10 The Morphology of *Trichomanes aphlebioides* Christ with special reference to the Aphlebioid Leaves By Dr S Williams Pp 142 152+1 plate 1s 6d (Edinburgh Robert Grant and Son London Williams and Norgate Ltd)

FOREIGN

Field Museum of Natural History Anthropology Memoirs, Vol 1 No 2 A Sumerian Palace and the 'A' Cemetery at Kish Mesopotamia Part 2 By Ernest Mackay (Field Museum—Oxford University Joint Expedition) Pp 63 215+plates 21 62 (Chicago)

Second Bibliography and Catalogue of the Fossil Vertebrata of North America Vol 2 By Oliver Perry Hay (Publication No 390) Pp xiv+1074 (Washington D C Carnegie Institution) 8 dollars

Plant Competition an Analysis of Community Functions By Frederic E Clements John E Weaver and Herbert C Hanson (Publication No 398) Pp xvi+340+32 plates (Washington D C Carnegie Institution) 3 25 dollars

CATALOGUES

Watson s Microscope Record No 20 May Pp 32 (London W Watson and Sons Ltd)

Early English Literature 15th to 17 h Centuries (New Series No 6) Pp 128+15 plates (London Francis Edwards Ltd)

Clearance List at Bargain Prices of Books on the Subjects of Entomology Geology Mineralogy and General Zoology including Mammalia Invertebrates and Ornithology (No 177) Pp 20 (London Dulau and Co Ltd)

Diary of Societies

FRIDAY, MAY 30

ROYAL SOCIETY OF MEDICINE (Disease in Children Section) (Annual General Meeting) at 5 —H A T Fairbank Osteogenesis Imperfecta (Presidential Address)

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts) at 6 30 —H R Ricardo The Development and Progress of the Aero Engine (Wilbur Wright Memorial Lecture)

ROYAL SANITARY INSTITUTE (in Public Halls Blackburn) at 7 —Dr J J Buchan and others Discussion on The Re organisation of Poor Law Hospitals under the Local Government Act

GEOLOGISTS' ASSOCIATION (at University College) at 7 30 —S Hall A Study of the Coastal Geology between Marazion and Porthleven Cornwall (Lecture) —Dr W G Shannon and L G Anniss The Igneous Intrusions of the Stoke Fleming Area South Devon

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Sir H C Harold Carpenter The Metal Crystal

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB —Dr N K Adam Some Aspects of Lubrication

SATURDAY MAY 31

ROYAL SANITARY INSTITUTE (in Public Halls Blackburn) at 10 45 A M Dr V T Thierens and others Discussion on The Need for Further Legal Powers with Respect to Ice Cream —H W Webb and others Discussion on The Provision and Maintenance of Dustbins—Private or Municipal

MONDAY JUNE 2

ROYAL SOCIETY EDINBURGH, at 4 30 —O F T Roberts On Radiative Diffusion in the Atmosphere —Dr D Jack A Simple Spectrum Comparator —W O Kermack R H Slater and W T Spragg Certain Quinoline and Benzacridine Derivatives yielding Coloured Adsorption Compounds with Iodine —S G Jones A Study of Apothecial Development in the Leaf Spot Disease of Red Clover —E L Ince Tables of the Elliptic Cylinder Functions

ROYAL INSTITUTION OF GREAT BRITAIN at 5 —General Meeting

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College) at 6 —Mrs E Norman Some Observations on the Speech of a Young Child

ROYAL SOCIETY OF MEDICINE (Odontology Section) (Annual General Meeting) (at Royal College of Surgeons) at 8 —Sir Frank Colyer Demonstration on Specimens in the Odontological Museum —C Harborow A Complex Odontome —J G Turner A Histological Report on the Odontome

ROYAL GEOGRAPHICAL SOCIETY (at Eolian Hall) at 8 30 —B Thomas A Journey to the Centre of the Rub al Khali

INSTITUTION OF ELECTRICAL ENGINEERS (Summer Meeting at Irish Centre) (June 2 6)

TUESDAY JUNE 3

SOCIETY OF GLASS TECHNOLOGY (Jointly with Deutsche Glastechnische Gesellschaft) (at Institution of Mechanical Engineers) at 10 A M —Prof W E S Turner A Study of the Chemical Reactions in the Making of Soda Lime Silica Glass —Prof E Zschimmer On the Theory of the Constitution of Glass.—T C Moorshead and E A Coad Pryor Some Experiments on the Cascade Method of Melting Glass —Dr E Berger Influence of Thermal History on the Properties of Glass.—At 2 —Prof W L Bragg The Structure of Silicates —Prof G Gehlhoff Currents and Temperatures in the Glass Tank —H W Howes Volatilisation from Soda Lime Silica Glass —Gehr Reg Rat. Dr A Wendler Development and Trend of the Mechanical Production of Colourless Hollow Glassware

RESEARCH DEFENCE SOCIETY (Annual General Meeting) (at 11 Chandos Street, W 1) at 3 15 —Mrs E Mellanby Diet and Dental Disease (Stephen Paget Memorial Lecture).

MINERALOGICAL SOCIETY, at 5 30 —Dr L J Spencer On a New Meteoric Iron from Piedade do Bagre, Minas Geraes, Brazil —Miss Jessie M Sweet Notes on British Barytes —M H Hey On Face and Zone symbols referred to Hexagonal Axes —Dr L J Spencer Biographical Notices of Mineralogists Recently Deceased (fourth series). —Dr F Walker On a Tholeiitic Phase of the Quartz dolerite Magma of Central Scotland —M H Hey On Pink Epsomites and Fauserite

ZOOLOGICAL SOCIETY OF LONDON, at 5 30 —Dr G C Low D Dewar, T H Newman, and G A Levett Yeats A Classification of the Original Watercolour Paintings of Birds of India by B H Hodgson, S R Tickell, and C F Sharpe in the Library of the Zoological Society of London —P E P Deraniyagala Testudinate Evolution — Margaret C Stean The British Museum Collection of Amphibia from the Middle Coal Measures of Linton Ohio U S A —A Girgis The Development of the Heart in the Rabbit —Dr G S Sansom and Dr J P Hill Observations on the Structure and Mode of Implantation of the Blastocyst of Cavia —Agnes E Miller Note on the Tail Skeleton of *Lepidosiren paradoxa* with Remarks on the Affinities of *Palaeospondylus*

LONDON NATURAL HISTORY SOCIETY (at Winchester House) at 6 30 — E R Taylor The Pyramids and the Sphinx

ILLUMINATING ENGINEERING SOCIETY (Annual Meeting)

WEDNESDAY, JUNE 4

PHYSICAL AND OPTICAL SOCIETIES (Joint Discussion on Photo electric Cells) (at Imperial College of Science and Technology), from 3 to 5 30 —Prof H S Allen The Early History of Photo electric and Selenium Cells (Introductory Lecture)—Dr N R Campbell A Theory of Selective Photo electric Emission with Special Reference to Thin Films of Caesium on Silver —D H Loughridge The Manufacture of Photo electric Cells and their Use in Sound Reproduction —T W Case (a) The Thalofide Cell (b) Barium Photo electric Cells —P Selényi The Manufacture, Properties and Use of Sodium Photo electric Cells —J Kunz Photo-electric Cells and Some Applications — Major C E S Phillips The Manufacture of Selenium Cells —From 5 30 to 7 Demonstrations

FARADAY SOCIETY (at King's College) at 5 30 —Prof T H Laby Quantitative and Qualitative Analysis by X Rays —J T Calvert The Determination of Potassium in Soil Samples by the Application of an X Ray Method

THURSDAY, JUNE 5

PHYSICAL AND OPTICAL SOCIETIES (Joint Discussion on Photo electric Cells) (at Imperial College of Science and Technology) from 10 30 to 1 —Dr N R Campbell The Standardisation of Photo electric Cells Dr N R Campbell and L G Stoodley Time lag in Gas filled Photo electric Cells —E B Moss A Complete Electrostatic Method for the Measurement of Photo electric Currents —Prof G M B Dobson and D S Perfect A Method of Comparing Very Small Amounts of Light by Means of a Photo electric Cell and a Valve Amplifier —N L Yates Fish A Theoretical Investigation of the Use of a Photo electric Cell with a Valve Amplifier —H A Thomas A Theoretical Study of the Amplification of Photo electric Currents by Means of Thermionic Valve Amplifiers —H Geffcken and H Richter Distortion in the Amplification of Photo-electric Currents and a Remedy —Prof G M B Dobson A Spectrophotometer for Measuring the Amount of Ozone in the Upper Atmosphere —D S Perfect A Method of Measuring Small Angles —C H Sharp Notes on Photo electric Photometry —T H Harrison The Photo electric Cell as a Precision Instrument in Photometry —From 3 to 5 30 —Drs W R G Atkins and H H Poole On the Photo electric Measurement of Daylight —Drs J H J Poole and H H Poole The Neon Discharge Tube Photometer —P P Koch Die Photoelektrische Zelle als Hilfsmittel der Registrier photometrie —E A Baker Some Factors Affecting the Speed of the Koch Micro photometer —K S Gibson The Use of the Photo electric Cell in Spectrophotometry —D S Perfect Spectrophotometric Absorption Measurements —H D Griffith Photo electric Photometry in Relation to Phototherapy —V E Shelford The Use of Photo electric Cells in Biological Work

CHEMICAL SOCIETY at 8 —A W Chapman The Influence of a Soluble Fluoride on the Corrosion of Iron —G B Harrison The Application of a New Type of Triode Valve to the Determination of Hydrogen Ion Concentration with Glass Electrodes —E H Farmer and T N Mehta Properties of Conjugated Compounds Part X Variability in the Mode of Ester addition to Butadiene Esters and Ketones

FRIDAY JUNE 6

GEOLOGISTS ASSOCIATION (at University College), at 7 30

SATURDAY, JUNE 7

GEOLOGISTS ASSOCIATION (June 7 to 10) (at Star Hotel Helston).—A Study of the Coastal Geology between Marazion and Porthleven, Cornwall

PHYSIOLOGICAL SOCIETY (in Physiology Department, Edinburgh University)

PUBLIC LECTURE

THURSDAY, JUNE 5

INSTITUTE OF PATHOLOGY AND RESEARCH ST MARY'S HOSPITAL, PADDINGTON) at 5 —Prof G E Gask The Value of Radium in Surgery

CONGRESSES

MAY 28, 29 30, and 31

SOUTH EASTERN UNION OF SCIENTIFIC SOCIETIES (at Portsmouth)

Friday, May 30 at 10 A M —H Dewey Cornish Geology and Scenery, with a Few Remarks on the Isle of Wight by Way of Comparison

At 11 A M —Lt Col J H Cooke, Origin of Scenery in the Portsmouth District, Geologically Considered

At 12 noon —Prof L S Palmer Recent Geology of the Portsmouth District

At 10 A M —J F Marshall The Organisation of Mosquito Control Work

At 11 A M —Miss G F Selwood Observations on Fauna Changes in a Bog at Bembridge, I W

At 8 P M —L R Benny Progress in Astronomy

Saturday May 31, at 10 A M —G E Hutchings Some Applications of Regional Survey in Education.

At 10 45 A M —A Farquharson A Regional Survey of Chichester

At 11 30 A M —D H Thomson Springs, Streams, and Wells in the Portsmouth District

JUNE 3 TO 5

INSTITUTION OF GAS ENGINEERS (Annual General Meeting and Conference) (at Town Hall Leeds)

C F Broadhead The Preparation of a New Road Binder

Dr Margaret Fishenden Heat Transmission with Particular Reference to Modern Methods of Expressing Convection Data.

Dr E W Smith Gas Dehydration

F G Stewart The Functions of Coke Ovens

F Prentice Experiences with a Waterless Gasholder

W H Hoffert and G Claxton Benzole Recovery with Particular Reference to Gas Works Practice

JUNE 4 TO 9

ROYAL INSTITUTE OF PUBLIC HEALTH (at Portsmouth)

Thursday, June 5 from 9 30 A M to 1 —Prof H R Kenwood The Reduction of Preventable Disease—A Few Observations Thereon

D Aulland and others Discussion on National Health and the Local Government Act of 1929

Dr C F White Plague Prevention in English Ports

S Cade Radium and Cancer Clinics

Prof R J A Berry Heredity in Relation to the Nation's Problem of Mental Deficiency

H C M Williams Port Administration

Prof Sir Thomas Oliver The Health of the Worker of To day

Dr W Hanna and others Discussion on Health in Sea faring Occupations

Dr W J O Donovan Occupational Skin Diseases with Special Reference to Cheiropompholyx

F G Bowen Some Geographical and Anthropological Factors in the Study of Industrial Diseases.

Dr A W Sanderson The Health of Women and Girls in Industry

Lady Keyes The Voluntary Worker in Relation to the Public Health Service

Dame A Louise McIlroy and others Discussion on The Prevention of Sickness and Death in Motherhood

Dr I Dorothea Taylor The Health of the School Child

Dr M Critchley The Problem of the Epileptic Child

B Purse The Care of the Blind Child

Col R K White Post Puerperal Disabilities in Women

Sir Henry Gauvain Sun Treatment in England

Dr H M Davies and others Discussion on The Present Position of Surgical Treatment of Pulmonary Tuberculosis

Dr J Gravesen The Early Phases of Tuberculosis and their Treatment

O Amrein The Development of Pulmonary Tuberculosis and the Differential Diagnosis

Thursday June 5 from 10 A M to 1 —Surg Rear Admiral H C Whiteside Some Problems Old and New of the Seafaring Doctor

Major H S Blackmore Points of Contact—The Medical Officer in Charge of Effective Troops links up with the Regimental Officer

Major H N Stafford The Service Doctor and Medical Science—His Contribution

Surg Capt F C B Gittings Has the Naval Service any Ophthalmic Sequels?

Major D T Richardson Experimental Work on Three Types of Stretcher Slings

Prof R Crochet Post Encephalic Parkinsonism and Military Pensions

Friday June 6 from 9 30 A M to 1 —Dr C K Millard and others Discussion on The Slum Problem

Dr C O Stallybrass Variations in Virulence during the Course of Epidemics

Col R J Blackham Acid Milks in Health and Disease

Brig Gen J Charteris The Design and Requirements of Slaughter houses

A Moore Hogarth The Rat Menace

W Buckley National Health and our Milk Supply

Surg Commdr H D Drennan and others Discussion on The Health of Dockyard Workers

Dr H M Vernon New Methods of Heating Buildings and their Influence on Comfort

Dr R E White Sensitisation of the Skin

Dr Letitia D Fairfield and others Discussion on The Slum Child

Miss Doris M Odlum Home and the Adolescent

W Clarke Hall The Problem of the Delinquent Child

Miss B M Johnson The Hygiene of the Domiciliary Labour Room

Dr Olive B Sharp Ante Natal Treatment in Connexion with Venereal Disease

Dr J Watt The Provision of Institutional Treatment for the Tuberculous

Dr R R Trail The Results of Sanatorium Treatment Immediate and Ultimate

Dr Rollier The International Factory Clinic for Indigent Patients suffering from Surgical Tuberculosis

Friday June 6, from 10 A M to 1 —Squadron Leader A F Rook Sanitation in Desert Operations

Surg Commdr J A O Flynn The Control of Malaria at H M Naval Base, Singapore

Surg Capt. L M Morris Recruiting—Review of Modern Requirements.

Wing Commdr H A Treadgold The Conditions of the Heart found in Recruiting

Dr G C Low Climatic Bubo—Its Diagnosis and Treatment.

SATURDAY, JUNE 7, 1930

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Editorial and Publishing Offices

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Science and Philosophy

THE suggestion made by Prof F G Donnan in a letter which appears in our correspondence columns this week, that workers in natural science and philosophy should somehow be brought together in order to elucidate and discuss those fundamental problems with which both are concerned, will, we believe, be given careful consideration over a wide field of thought During the past twenty five years mathematicians and natural philosophers have been led to deal with problems of an essentially philosophical character, while purely philosophic workers from their side have been tending more and more to concentrate attention upon those same problems and to attempt to prepare the way for a more adequate solution of them Most of the really fruitful work in philosophy during the present century has been devoted not to elaborating great speculative systems, but to careful detailed research upon such specific problems as the nature of sense data and their relation to physical entities, the character of space and time in their relation to one another, the basis of scientific induction, the interpretation of life, the relation of mind to Nature, and so on This has been the case not in Great Britain alone, but also on the continent of Europe, as, for example, in the extremely valuable work that has emanated from Husserl and his pupils, one of the most original of philosophic thinkers in Germany at the present time

It is obvious that one of the chief difficulties in all such investigation is that it is impossible nowadays for any one individual to be an expert in more than one or two of the various departments of knowledge upon which the problems referred to touch Few things would be more helpful to the advance of philosophic thought at the present juncture than a combined effort on the part of men of science and workers in philosophy to face the issues which from both sides are being forced upon human reflection The old hard and fast distinction between science and philosophy can no longer be sustained, and the time has come when it should be explicitly recognised that philosophy is, in truth, a branch of science

It is being more and more widely recognised that on one hand the predominantly classical tradition in itself is seriously inadequate to modern tendencies, while, on the other, the difficulties arising from the steadily increasing scientific specialisation are patent Science is being compelled, merely by its own incessant expansion, to investigate its ultimate basis This is pre eminently a philosophical problem of the most intricate order, while the indispensable specialisation practically excludes

the requisite acquaintance with the governing philosophic principles and methods The conclusion seems obvious that research must be complementary, and also systematically directed so far as this is possible without interfering with individual initiative It is well to remember that Aristotle was both a great scientific pioneer and a great metaphysician

The progress of physical research in the early years of the twentieth century had a profound effect on the minds of both scientific workers and philosophers The implication of the theories of relativity and quanta, particularly in relation to notions of space and time, brought the physicist and the mathematician into the realms of philosophy The excursion was not popular Many scientific workers felt alarm and discouragement at the tendency of physical science towards metaphysics, they feared that the doubt and obscurity which have characterised much of the metaphysics of past centuries would invade their science

Among the philosophers there was a movement to grapple with the new problems presented by experimental philosophy Thus we find Prof H Wildon Carr publishing a work entitled "The Scientific Approach to Philosophy" (1924), in which he sets forth his views on the relation of science to philosophy, adopting the view that the fundamental distinction is that, whereas philosophy seeks to see reality as a whole, science is more concerned with particulars, proceeding to laws rather than to a systematic whole Mr Bertrand Russell, on the other hand, believes that the subject matters of science and philosophy are identical and both start from the same point but proceed in opposite directions Prof A N Whitehead, who is also mathematician and philosopher, has formulated a philosophy of Nature through the study of the history of science Only within the last few days a work in which physical science and philosophy are combined, by another pioneer investigator and thinker, has reached us We refer to Sir Oliver Lodge's "Beyond Physics", which aims at the beginning of a philosophical outlook which shall include a basis for life and mind of a physical, though non material, character

This work may be taken as an example of the change which has come over positive science during the past quarter of a century or so, referred to by a reviewer in a notice of Prof Dotterer's "Philosophy by Way of the Sciences" in Nature of April 5 'Not less striking", he remarked, after indicating the changes in the pursuit and teaching of philosophy, "is the changed attitude of men of science, their modified faith in mechanistic explanations of life, and especially of the life of man, their consciousness that every line of scientific inquiry leads to problems which (using the word physics in its older and more general sense) are beyond physics, that is, are metaphysical Hence the present position, that some of our leading men of science are also among our leading philosophers"

Conditions thus seem to be favourable for a closer *rapprochement* between science and philosophy, with the double purpose of working out a real philosophy of Nature and of undertaking a critical overhaul of scientific concepts, perhaps more especially in the biological field Whether at the moment much would be gained by an international meeting devoted exclusively to questions of the relations between science and philosophy is, however, doubted by representative workers in both fields There is a feeling that the common basis of the two groups would be found to be disappointingly small, and that in the absence of sufficient mutual understanding the outcome would be more disruptive than unifying Long range discussion in separate scientific and philosophical journals, and interchange of views between men of science and philosophers at their respective congresses, are helpful in presenting the different points of view, and their extension would be welcomed When the different workers find themselves in the same field they will naturally desire to join in periodical meetings or conferences to consider promising lines of development

At the meeting of the British Association in South Africa last year, General Smuts and other philosophers spoke on questions of interest to both men of science and philosophers, and one of the subjects to be discussed at the International Congress of Philosophy, to be held in Oxford next September, is the question of the metaphysical importance of recent advances in physics As General Smuts is to be the president of the British Association at the centenary meeting in London next year, we suggest that a small joint committee might be appointed representing the British Association, the British Institute of Philosophical Studies, and the Aristotelian Society, to draft a programme of appropriate papers for discussion during the meeting There is at present no Section of the British Association devoted to what may be called scientific philosophy, but philosophic minds are to be found in all the Sections, and it should be possible to arrange a special meeting for the discussion of the basis of all knowledge Perhaps someone will bring the matter forward at the International Congress of Philosophy with the view of getting a joint committee appointed to effect the co operation desired, whether through a periodical international assembly or otherwise

Is Humanism Dead?

Publii Ovidii Nasonis Fastorum Libri Sex *The "Fasti" of Ovid* Edited with a Translation and Commentary by Sir James George Frazer Vol 1 *Text and Translation* Pp xxxi + 357 Vol 2 *Commentary on Books I and II* Pp v + 512 Vol 3 *Commentary on Books III and IV* Pp v + 421 Vol 4 *Commentary on Books V and VI* Pp v + 353 Vol 5 *Indices, Illustrations, Plans* Pp xiii + 212 + 95 (London Macmillan and Co, Ltd, 1929) 5 vols, 126s net

AMONG other fashionable revolts of to day, our reaction against the classics is perhaps a minor, but a vexatious and disruptive crisis, which, while it affects primarily education, also enters deeply into our whole cultural outlook The radical spirits of the day are definitely anti classic The conservative tendency, on the other hand, still leads many thinking people to affirm that no man of science or sociologist has ever rivalled Aristotle, no thinker reached the heights of Plato, and that no philosopher is more worth studying than Democritus, Thales or Anaximander People also still speak of the absolute necessity of memorising Latin cases or of conjugating Greek verbs in order to understand the working of human speech or to acquire the faculty of logical thought This of course is an untenable line of defence of a cause not altogether lost

The grip of dead tongues on the study of language is and has always been pernicious The habit of framing all our linguistic conceptions and grammatical categories on a language which we never can use in its principal function—of living speech between living people and in a living culture—has made philology lose touch with real life and become a barren discipline Again, it is but an affectation to treat the scientific and philosophical work of classical writers as anything but wonderful documents of a past culture As direct contributions to modern scientific knowledge they are obviously worthless

Yet all sane people have an uneasy feeling that it is impossible to dispose thus lightly of humanism We cannot sweep away the influence of classical antiquity on our own culture Nor can we banish philological methods from our schools, our philosophies, our social sciences—any more than we can drop the influence of Greek or Latin on our vocabulary and grammar Classical antiquity has become an essential part of our civilisation—a living myth upon which our culture is built For every culture has to rely upon a retrospective vision, a grand illusion of a Golden Age, lawgiving and inspiring, supplying the present with a life drawn from the past

The historical myths of our own civilisation are the belief in the divine inspiration of the Jews, in the Olympic beauty and wisdom of the Greeks, in the political majesty of Rome as the fountain head of law and statecraft The fact that some of us have come critically to doubt whether Greek sculpture is more perfect than Japanese decorative art, or to suggest that the Indian epics might equal Homer, or that the social and political systems of China are as worthy of study as those of Rome, will never change the fact that emotionally we find our 'promised land' around the eastern basin of the Mediterranean, that somehow Athens, Rome and Jerusalem have acquired a dominance over our emotions as well as over our thought

The anthropologist above all must believe in the continuity of tradition, and whatever defects our classical tradition has, it cannot be jettisoned Classical interests must and will receive ever-widening scope and an increasingly greater depth through constructive criticism Our knowledge of Greece and Rome must be placed within the context of other cultures In this sense, humanism, as living mythology and inspiring science, is not dead and never will be

If we define, then an anthropologist as one who passionately loves the continuity of tradition and works for its preservation and development, who also brings to this task a profound knowledge of our own mythology as well as of the superstitious of other savages—Sir James Frazer is the greatest anthropologist of our age He is also one in the long line of succession of great humanists For, constantly reshaped by criticism from within and without, humanism has, in fact, grown from a narrow and rigid discipline to that all embracing vision of humanity as a whole which, in Great Britain and this generation, has given us the works of Jane Harrison, Gilbert Murray and James Frazer The five volumes of the "Fasti" which mark Frazer's return to applied anthropology and to first hand classical research and reinterpretation, naturally provoke these reflections

The earliest humanists who awoke to the reality of Greek and Latin civilisation from the dead grip of medieval scholasticism and Church tradition, regarded ancient writing and ancient art as a revelation unto itself When, through the discoveries of comparative Indo European linguistics, the scope was widened, we were shown that,

through the sacred books of the East, and through the comparative study of Sanskrit and Zend, Celtic and Slavonic, a new meaning could be given to the religious conceptions of Greek polytheism, to the institution of the Mediterranean patriarchal household, and to the legal norms and historical vicissitudes of the Hellenic and Italic peoples But it was only by placing Latin and Greek culture in the widest comparative survey that the full humanistic meaning could be given to all that is beautiful, and all that is crude and barbarous, in customs and beliefs revealed to us by Virgil and Ovid, Homer and Sophocles

In this work of revealing to us the full human meaning of Greek and Latin culture, Frazer started with his classical interests The six volumes of his "Pausanias" give us a vision of ancient Greece as it was in the times of Imperial Rome In his "Golden Bough", starting from one of the most inexplicable and barbarous customs recorded from Latium, Frazer gives us the theory of primitive culture and of the rational savagery of human faith, a theory which will for ever remain a masterpiece of comparative anthropology Then the great Cambridge scholar, casting himself for a time completely adrift from his Mediterranean moorings, explored the remote continents of Africa, Australia and the New World, discovering the real nature of totemism and exogamy, interpreting, in the "Worship of Nature", the relations between primitive man and his environment, giving, in the "Belief in Immortality and the Worship of the Dead", a new insight into the desire for survival, and, mindful of another 'promised land', he analysed folk lore in the Old Testament, with an insight into Semitic spirit and culture only rivalled by his Greek and Latin scholarship

Now, again, in the "Fasti" of Ovid, he returns to his original interest, and in the running commentary to the poetic version of the Roman calendar, shows once more the kinship between ancient classical belief and that of humanity at large In the first volume we are given the Latin text and the translation, characterised by Frazer's accuracy and learning, as well as by his sense of beauty both in English and Latin But, as we read it, there arise at every step those queries and enigmas which not even the best translator can overcome in a direct rendering Indeed, Frazer needs three bulky volumes of comments to his short half volume of translation But these volumes are not merely a commentary on Ovid and his Roman calendar, but on the whole life of the Roman nation For a pious and practical people like the Romans marked down in their programme of the year, besides historical and legendary landmarks, also dates of religious or magical importance, days of economic or political significance, festivities which affected the family, the city, and the State Thus a great deal of Roman civilisation, projected along the weeks, months and seasons, unrolls before the reader in its yearly sequence

Right from the beginning we are brought to the heart of the real interests which led man to systematise his times and occupations and wed them to the regular courses of sun, moon, and seasons Frazer comments on the 28th line of the poem, in which Ovid accepts the traditional version attributing to Romulus the institution of a ten months year So absurd did this legend appear to some scholars that no lesser a man that Joseph Scaliger and his much younger confrère G F Unger rejected it as a mere fallacy of crude folk lore Anthropology, however, not only endorses Ovid in his fabulous sources, but also can give us a full explanation of the apparent irregularity Frazer is able to show that an incomplete year, based as a rule on lunar divisions, is found all over the world, in defiance not merely of theoretics of the ten months year, but also of the innumerable theories given in explanation of this anomaly This shortened year is due simply to the fact that the real interest of an agricultural people is directed towards what happens on the surface of the earth and not on the vault of the heavens The calendar is determined by the cultivation of fields and the growth of crops, and not by the abstract rotation of stars and constellations Even in the counting of time humanity crawls on its belly, scarcely aware of what passes above and around

Line after line we follow the vagaries of Roman time reckoning, and of Ovid's explanations We learn about the widow's mourning, and about the unlucky periods of intercalary days and months We are led into an analysis of primitive licence, and of the annual mock kings This last subject leads us near to the theme of "The Golden Bough", to which the present book contains, incidentally, a great many riders and additions Especially interesting is the long commentary (vol 3, p 72) to the lines

"The strong of hand and fleet of foot do there reign kings, and each is slain thereafter even as himself had slain"

It would be quite impossible to give point for

point the gist of the many illuminating comments—some brief and pithy, others leading us far afield over the surface of the earth and into the ramifications of a belief or custom, but all pertinent and illuminating, all characterised by that solid grip on fact, by that reluctance to vague theorising, which are the greatest qualities of Frazer's work.

We acquire a great deal of comparative knowledge about the Latin divinities, Janus and Jupiter, Vesta and Juno; about the Lares and other family gods; about Roman family law and its Latin sources and the constitution of the household; about the Sacred Fire, beliefs concerning cross-roads, werwolfs and vestal virgins.

The fifth volume illuminates the learned body of the work with diagrams and illustrations, in the choice of which the author reveals himself again as a scholar and an artist. It also contains an excellent index.

Frazer, who, since the recent publication of this book, has given the world two more volumes on such widely different subjects as the logic and thought of Plato and the myths of the origin of fire, has demonstrated once more the vigour and fertility of the new science and of its master. Perhaps the highest praise that can be given the work under review is that it forms an indispensable compendium to "The Golden Bough", to which it constantly refers, and of which it is a worthy illustration and amplification.

B. MALINOWSKI.

Space and its Properties

The Size of the Universe: Attempts at a Determination of the Curvature Radius of Spacetime. By Dr. Ludwik Silberstein. Pp. viii + 215. (London: Oxford University Press, 1930.) 10s. net.

DR. SILBERSTEIN'S monograph is concerned with the hypothesis, now widely favoured, that space is not infinite, but is a closed domain analogous to the surface of a sphere. Besides giving a general account of this theory, it includes an exposition of certain views which have led him to an estimate of the 'radius of space' much smaller than the estimates of other writers. Whatever reservations we may wish to make with regard to this controversial part of the work, the book as a whole can be cordially welcomed. It is written lucidly, vividly, and with keen flashes of insight. It can scarcely be read by a non-mathematical reader; but the mathematician is not delayed with details, and is guided quickly and racily to the interesting results. The style of expression brings to mind vividly its enthusiastic and impetuous author. The reader may not always agree, but he will enjoy disagreeing with so ingenious an advocate.

Silberstein rejects the spherical world of Einstein and adopts that of de Sitter. This is in accordance with general current opinion; and in any case de Sitter's is the better working hypothesis, since it is the one which has interesting astronomical consequences. Whilst agreeing with his choice, we cannot agree with the reason on which he lays most stress. He seems to regard it as a blemish of Einstein's world that its equations do not admit of the insertion of a particle of matter (a mass centre), whereas de Sitter's admit it. But, when examined, this superiority of de Sitter's world is found to arise from the fact that it is entirely empty; the insertion of a gravitating particle does not upset its equilibrium because there is nothing to upset. When de Sitter's idealised conception is modified into a practical astronomical universe, this supposed advantage is the first property to be discarded.

It is a feature of de Sitter's world that every particle appears to be repelled from the observer with an acceleration proportional to the distance, so long as the distance is small compared with the radius of space. (The law of acceleration at large distances depends on the definition of distance adopted.) In consequence of this, the symptom of world curvature that has been looked for by most authorities and used as the basis for estimating the size of the universe is a velocity of recession of distant objects increasing with the distance. This effect is shown markedly by the spiral nebulæ, which are the most distant objects known. Silberstein differs from everyone else in taking the symptom to be an increase of average speed with distance, irrespective of whether the motion is receding or approaching; he uses for his material star clusters and even stars, which have no marked preponderance of receding velocities. In considering this divergence, it must be borne in mind that we know only the present velocities of celestial objects, and it is, of course, impossible to say that a particular instantaneous distribution of velocities is irreconcilable with any assumed field of force. The most we can do is to connect the field of force and the velocity distribution by some plausible theory of the origin and development of the present state of affairs. We have not space to describe Silberstein's claim to plausibility; it is ingenious but we do not find it convincing.

Some months ago Dr Silberstein caused a mild sensation by announcing a radius of the universe so small that it left the astronomer scarcely room 'to swing a cat in' This calculation is given by him in an appendix, it gives a mere 2,000,000 parsecs for the radius of space (The nearest spiral nebula is distant about 300,000 parsecs) The result depends on stellar motions only We naturally object that inasmuch as world curvature obviously does not explain the main features of stellar motions, it is unreasonable to suppose that it is the only effect to be considered in interpreting their minor correlations In fact, the phenomenon attributed by Silberstein to space time curvature appears to be one which is more usually ascribed to galactic rotation His older value used in the main part of the book was eighteen times greater, and it demands considerable mental agility on the part of the reader who wishes to review the arguments in accordance with the reduced scale

Three years ago a very substantial advance in this subject was made by Abbé G Lemaître (*Annales de la Société Scientifique de Bruxelles*, April 25, 1927) Until recently, this paper seems to have been almost unknown, and we can scarcely blame Dr Silberstein for being unaware of it, but it is unfortunate that the new point of view does not appear in his book In particular it renders obsolete the contest between Einstein's and de Sitter's cosmogonies We can now prove that Einstein's universe is unstable The equilibrium having been disturbed, the universe will progress through a continuous series of intermediate states towards the limit represented by de Sitter's universe By Lemaître's analysis the history of this progress can be studied, and the intermediate stages (one of which must represent the present state of the world) can be treated in detail

A S EDDINGTON

Classification of the Octopoda

A Monograph of the Recent Cephalopoda based on the Collections in the British Museum (Natural History) Part 1 *Octopodinæ* By G C Robson Pp xi + 236 + 7 plates (London British Museum (Natural History), 1929)

IN the present volume, the first instalment of a systematic account of the recent Cephalopoda, Mr G C Robson has attacked the most difficult part of the work—the classification of the subfamily Octopodinæ, the largest division of the order Octopoda The difficulty of classification is enhanced by post-mortem changes which modify or efface the sculpture of the skin and distort the shape of the body and head, by the amount of material available for the study of a single species being generally limited, and hence the amount of variation of the species unknown, and by the defective descriptions of earlier workers, which are often based on more or less valueless characters The author directs attention to the need for intensive studies on the variation of a single species carried out on living examples, and gives the results of an examination of a number of characters in twenty one specimens of *Octopus vulgaris*

A brief description of the structure of the genus *Octopus* deals especially with the features which are important in classification and is followed by a short account of the habits and a note on the characteristics of young forms

In his remarks on phylogeny and classification, the author states that the sub family seems to be broken up into a large number of disconnected and often monotypic groups rather than along well defined lines of evolutionary significance He has, however, reviewed the evidence with the object of obtaining indications as to the characters of the primitive Octopodine, and concludes that these were—rather short, equal arms, a low equal web, probably a W-shaped funnel organ, numerous gill filaments, a small undifferentiated hectocotylus, simple rhachidian teeth on the radula, a superficially placed ink sac, and a widely open mantle aperture

The Octopodine species which have been adequately described fall into the genus *Octopus* (with five sub genera) and eight other genera For these species tables of measurements and other details—in most cases of thirteen characters—are given This is followed by the systematic account in which each genus is defined, the type species designated, and remarks added on matters of historical import For each species the synonymy is given, the locality of the type specimen is stated where this has been traced, a note of the specimens examined, a statement of the known distribution, a description and remarks are added A list of sixty seven insufficiently diagnosed species of *Octopus* is appended, and a brief account added of three species of uncertain generic position A bibliography and an index—both adequate—complete the text

The author is to be congratulated on his method of handling a very difficult subject, which has involved much detailed work and careful analysis and consideration

Our Bookshelf

Recollections of My Youth By Ernest Renan Translated by C B Pitman Pp xlvi + 360 + 2 plates (London George Routledge and Sons, Ltd, 1929) 7s 6d net

THIS new edition of Renan's second most famous book has the great additional advantage of an introduction by Dr Coulton It may well be, as Dr Coulton suggests, that these autobiographical reminiscences will survive the long and solid works in which Renan condensed the learning of his time If so, it will be due more, one may think, to the charming picture he has left us of the Breton life and country and friends of his youth than to the account of the long drawn struggle which took him at last from his early faith and intended profession

Most people who have a sense for such things have read the "Souveneur de Jeunesse" long ago, but they would do well to renew their acquaintance in Mr Pitman's quite competent and readable translation, and with the aid of Dr Coulton's useful sign posts It must suffice here to note two passages of special interest to scientific readers, one of which is quoted by Dr Coulton in his introduction Renan, writing after these "Souvenirs" in 1891 just before his own death in 1892, uttered one of the most remarkable judgments on public affairs on record "My dear children of the new generation, how many things you will know forty or fifty years hence which I shall never know! How will the inmost soul of the Kaiser William II develop? What will be the end of the conflict of European nationalities? What turn will the social question take? What will be the coming fate of the Papacy?"

The other passage occurs towards the end of the "Souvenirs" themselves There was a moment before Renan left St Sulpice when he might have taken up the study of natural science, and he says that he much regrets that he did not do so "It is by chemistry at one end and by astronomy at the other, and especially by general physiology, that we really grasp the secret of existence of this world and of God, whichever it may be called" Possibly, if he had done so, mankind might have gained from a mind so industrious, synthetic, and humane, a view of scientific evolution as a historic whole which we have still to build He would scarcely have been a great discoverer, he might have been one of the greatest historians of science F S MARVIN

Steam and Gas Engineering a Text covering Power Generating Apparatus utilising Energy released by the Combustion of Fuels By Prof Thomas E Butterfield Pp xv + 481 (London Macmillan and Co, Ltd, 1929) 18s net

PROF BUTTERFIELD holds the chair of heat power engineering at Lehigh University, and his text book has been written to fill what he felt to be a real lack in material for teaching the subject He is therefore concerned more with elementary principles and general descriptions of plant than with the work of the designer and the operating engineer, and the student who wishes to master any branch of heat power engineering will have to supplement his reading by consulting the books and articles mentioned in the bibliographies appended to each chapter Most of the books referred to are either British or American

The book may be divided roughly into four sections, the first treating of fuels, combustion, boiler furnaces, grates, the boilers themselves and their auxiliaries, the second deals with the various types of reciprocating steam engines, the third with steam turbines, and the last with internal combustion engines Though owing to the extensive use of the motor car the aggregate horse power of internal combustion engines exceeds the total horse power of steam plant, yet the place occupied by the latter in central power stations gives it the greatest engineering interest, and more space is thus given to steam than to gas and oil

All the usual features found in steam plant are dealt with, including mechanical stokers and condensing plant, and there are chapters on heat and work, the properties of steam, the laws of gases, gas and steam cycles, and the nozzle and blade calculations for steam turbines, and the student thereby gets a broad foundation on which to base his further studies A few historical notes are given regarding gas and oil engines, and similar notes might well have been given on steam engines and steam turbines It is somewhat strange to read descriptions of steam turbines without meeting with the name of Parsons

Kristallzeichnen Von Dr Robert L Parker Pp vi + 112 + 50 Zeichenblattern (Berlin Gebruder Borntraeger, 1929) 20 gold marks

THIS is one of the few books which deal exclusively with the drawing of crystals It consists of a threefold division into text, tables, and drawing sheets The text forms a practical introduction to crystal drawing, and theory is well blended with practical application

The first few chapters are devoted to general questions such as the choice of a projection, and to the older methods of drawing as on the projection of the crystal axis, and with the aid of the stereographic and gnomonic projections The position of the projected axes is given by co ordinates (Weber's method), and a chapter is devoted to the method of determining the co ordinates for the orthographic and clinographic projections in the case of each crystal system Each method of drawing is illustrated with worked examples

In the second half of the book is explained the author's new "Bildkantenazimute" method This, without loss of accuracy or applicability, offers a great saving in time and labour over the older methods, and has the great advantage that it does away with confusing constructional lines The slope of the edges is given by an angle measured in azimuth from a fixed point The angles are derived by a simple calculation from the co-ordinates of the axial cross and the indices of the edges together with the axial ratio Once calculated, the values are then available for all subsequent drawings of the same species Prepared drawing sheets allow of rapid plotting of the edges

The method may be adapted to any projection, but in the tables are given the angular values for the orthographic and basal projection for twenty minerals in addition to all the cubic values It is the obvious method to use in drawing cubic crystals The text is well illustrated

The Journal of the Institute of Metals Vol 42 Edited by G Shaw Scott Pp xii + 846 + 48 plates (London The Institute of Metals, 1929) 31*s* 6*d* net

The original papers contained in this volume were presented at the meeting of the Institute in Dusseldorf last autumn, and include several contributions from Continental metallurgists They fall into three main groups The first includes a general discussion on metallographic methods, as well as separate papers on dilatometry Here will be found a useful survey of modern methods of investigation, including some of very recent development A second group is concerned with recent progress in melting and casting non ferrous metals, special attention being given to electric heating The extent to which electric heating has replaced the use of direct fuel in the German copper and brass industry is very striking, and the laboratory metallurgist, accustomed to the difficulties of vacuum operations, may be surprised to find that charges of as much as four tons of metal have been successfully cast *in vacuo*, an induction furnace being used for the purpose

The subjects of corrosion and chemical attack are represented by several papers, one of which deals interestingly with the formation of patina on copper, and another with the wastage of locomotive fire box stays The influence of the Non ferrous Metals Research Association in encouraging and supporting work of scientific as well as of practical interest is conspicuous The abstracts and bibliography occupy no less than 360 pages, and this section of the volume is, as usual, very thorough in character, and indispensable to the metallurgist

Applied Inorganic Analysis with Special Reference to the Analysis of Metals, Minerals, and Rocks By Dr W F Hillebrand and Dr G E F Lundell Pp xix + 929 (New York John Wiley and Sons, Inc , London Chapman and Hall, Ltd , 1929) 42*s* 6*d* net

This important work is the result of prolonged experience on the part of both authors, whose publications on analytical subjects are well known Although attention is more especially directed to metal, mineral, and rock analysis, the book is really a general treatise on quantitative analysis, and as such will appeal to a wide circle of readers The treatment is essentially practical, and the details necessary for successful procedure are carefully described

References to the literature are given very fully, and a great number of critical observations and comparisons of methods add considerably to the value of the book The treatment is not exhaustive, and the reviewer has failed to find more than one method which he has himself used with success, but the authoritative treatment of the methods selected is entitled to the high praise which the book as a whole fully deserves Although the price is somewhat high, the saving of time which the possession of the book will realise makes it worth the cost Every chemical laboratory will find the book of great value

Anthropology of the Syrian Christians By Rao Bahadur L K Ananta Krishna Ayyar Pp xvii + 338 + 48 plates (Ernakulam Cochin Government Press, 1926)

The Syrian Christians of Malabar are, in their way, one of the most interesting communities in India Originally a single community, they afterwards divided themselves into various sects in circumstances over which they had no control, each with its divergent set of social customs and religious differences Yet all of them claim equally to be descended from, and themselves to be, true followers of the Apostle Thomas They have on many occasions attained prominence from their numerous and interminable disputes about the possession and administration of church property, a character, however, in which they are not peculiar either in India or elsewhere

Mr Krishna Ayyar's investigations into the manners and customs of the Syrian Christians of Malabar, Cochin, and Travancore were originally made so long ago as 1910, and the results embodied in vol 2 of "Cochin Tribes and Castes" Later opportunities for intensive study have enlarged the material, and the Cochin Government has now sanctioned its publication in a separate volume Four chapters are given to the history of the Syrian Church, and the remaining thirteen are devoted to the description of manners and customs It is interesting to note that not only are there many survivals of Hindu customs among these Christians, but also they show the same tendency to frequent fission into sects which is to be observed in the formation of castes and sub castes by division among the Hindus

The Statesman's Year Book Statistical and Historical Annual of the States of the World for the Year 1930 Edited by Dr M Epstein Sixty seventh Annual Publication Revised after Official Returns Pp xxxi + 1458 (London Macmillan and Co , Ltd , 1930) 20*s* net

The changes in the new issue of this familiar work of reference are in matters of detail The political world has been relatively quiet and there are few changes of frontiers or adjustments of territory to be recorded except the acquisition by Norway of a few polar islands Yugoslavia now appears under that official name in place of the old Serb, Croat, and Slovene State As usual, the revision of detail has been thorough, and an immense mass of useful statistical and descriptive matter appears within a small bulk The copious bibliographies of official reports and non official publications have been again revised There are two coloured maps, one showing Northern China with Manchuria and Mongolia, and the other Lithuania with the territory claimed by both that State and Poland The usual introductory tables give world output of various commodities

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications*]

Complete Spectral Diagrams of Crystals

IN NATURE of Dec 21, 1929 (vol 124, p 946), W Linnik describes a complete spectral diagram [1] of quartz produced by a conical X ray pencil, which pencil is obtained by the movement in two directions of a narrow pencil about a point The rays reflected

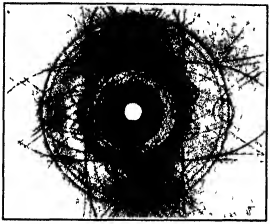

FIG 1

from inside the crystal come out on the side of the crystal opposite the source of rays and fall on a photographic plate A screen is moved with the ray and prevents the direct unreflected pencil from falling on the plate

This method permits the production only of a very

FIG 2

limited part of the complete spectral diagram Far more complete diagrams, as shown in Figs 1, 2, and 3 are obtained by reflection at the surface of a rock salt crystal backwards by using a very broad conical pencil Fig 6 of Seemann [2] shows the arrangement of apparatus to produce such diagrams, provided that the photographic plate is placed parallel to the surface of the crystal and not perpendicular

The chief difference from Linnik's diagrams consists in the presence of closed circles and ellipses The short hyperbolic segments of Linnik are only present in Fig 2 within the two circles In Fig 2 the focus was in the plane of the photographic plate—in Figs 1 and 3 it was not in this plane In addition to this, the

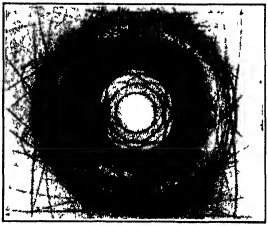

FIG 3

distances between the crystal and the point focus of the X ray tube and between the former and the photographic plate were different in the three diagrams A screen or diaphragm is not used in this method and all parts of the apparatus are kept fixed during the exposure

H SEEMANN
O KANTOROWICZ
K F SCHOTZKY

Seemann Laboratorium,
Freiburg i Br, May 7

[1] H Seemann *Physik Zeitschr* **20** 169 173 1919
[2] H Seemann *Ann Physik* **53** 461 491 1917

Adsorption from Solutions containing Two Solutes

ACCORDING to Gibbs's theory of capillarity, since the surface energy of a solution is at the minimum compatible with the other conditions of equilibrium, a substance which lowers the surface tension will be present at the interface in greater amount than in the bulk of the solution If two solutes are present, both of which lower the surface tension, it might be expected that that which causes the greatest surface tension lowering will be adsorbed to a relatively greater extent than the other If the difference is considerable, we may get the almost exclusive adsorption of the more active substance

We have determined, by means of the capillary electrometer, the surface tension lowerings produced at polarised mercury surfaces by solutions containing two surface active substances, and have found cases in which the lowering caused by the mixture is identical with that produced by the more active substance, when present alone For example, $M/20$ sodium *o* toluate by itself causes smaller surface tension lowerings than $M/20$ sodium cinnamate at all potential differences (Fig 1), and the electro capillary curve of the mixture is identical with that of $M/20$ sodium cinnamate When the sodium cinnamate concentration is reduced, while that of the toluate remains constant, the curve of the mixture remains identical with that of the cinnamate to below $M/50$ With $M/60$ sodium cinnamate, the effect of $M/20$ sodium toluate first becomes observable

The surface tension lowerings of $M/50$ sodium cinnamate and $M/20$ sodium toluate separately at $V = -0.3$ volt, are equivalent to 3.4 and 2.1 cm of mercury in our apparatus, so that a difference in the lowerings caused by the two substances of about 30 per cent is sufficient to prevent the adsorption of sufficient toluate to cause a measurable change of surface tension. We have obtained similar effects with seven mixtures of salts of organic acids.

Similar observations have been made with mixtures of two neutral substances. In many cases, owing to

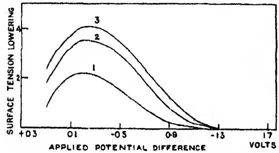

FIG. 1.—1. $M/20$ sodium o-toluate. 2. $M/50$ sodium cinnamate and $M/50$ sodium cinnamate + $M/20$ sodium o-toluate. 3. $M/20$ sodium cinnamate, and $M/20$ sodium cinnamate + $M/20$ sodium o-toluate.

the maximum surface tension lowerings occurring at different potentials, the curves of the two substances intersect and one substance causes the greater lowering on one side of the point of intersection, the other substance on the other side. In such cases we have found that the curve of the mixture approaches the higher curve on each side of the point of intersection (Fig. 2). Near the point of intersection the lowering is greater than that produced by either substance separately, but much less than the sum of the two. This type of behaviour is exhibited by the systems,

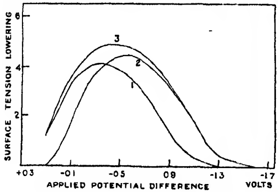

FIG. 2.—1. $M/20$ phenol. 2. $M/100$ caffein. 3. $M/20$ phenol + $M/100$ caffein.

caffeine phenol, phenol lactose, caffeine lactose, and salicin saccharose, all of which have been measured in $M/2$ sodium sulphate solution.

According to Langmuir's theory of adsorption as applied to the surfaces of solutions, the relation between the number of molecules of a solute adsorbed (Γ) and its concentration (c) in the solution is

$$c(1 - A\Gamma) = k\Gamma,$$

where A is the surface area occupied by each adsorbed molecule, and k a constant. It can be shown that this relation leads to Szyszkowski's equation, $\Delta\rho = \frac{RT}{A}\log\left(\frac{c}{a}+1\right)$, where $\Delta\rho$ is the surface tension lowering and $a = k/A$. Now $1 - A\Gamma$ is the fraction of the area of the interface which is unoccupied by any solute molecules, and if a similar relation applies when two solutes are present, the amounts adsorbed are determined by the equations

$$c_1(1 - A_1\Gamma_1 - A_2\Gamma_2) = k_1\Gamma_1,$$
$$c_2(1 - A\Gamma_1 - A_2\Gamma_2) = k_2\Gamma_2$$

It can be shown that these equations lead to the relation

$$\log_e \frac{(\Delta\rho_1)_{c_2}}{(\Delta\rho_1)_0} = -(\Delta\rho_2)_0 \quad \frac{A_2}{RT},$$

where $(\Delta\rho_1)_{c_2}$ is the lowering produced by the first substance in a solution containing the second substance at a concentration c_2, and $(\Delta\rho_1)_0$ and $(\Delta\rho_2)_0$ the lowerings produced by the two solutes separately at the concentrations at which they are present in the mixture. It has been found that this relation applies reasonably well to the data for neutral solutes, A_2 varying to a certain extent with the applied potential difference. In mixtures containing surface active ions, the effect of the less active substance is somewhat less than that predicted by the equation, probably owing to the electric field of the adsorbed ions hindering the adsorption of more ions of the same sign. A complete account of this work is to be published in the *Journal of Physical Chemistry*.

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Synapsis and Chromosome Rings in *Œnothera*.

IN a letter in NATURE of May 17, p. 743, Dr. Darlington, having observed what he believes to be parasynapsis or side by side pairing of threads during meiosis in certain plants, mostly allied to the Liliaceæ, where such conditions have been described before, assumes that meiosis in all other organisms must fit in with his particular scheme of events. Since 1911[1] I have been inclined to the view that some organisms conform more nearly to the parasynaptic story, while others agree essentially with the telosynaptic account. Certainly nothing that Dr. Darlington has observed has given me any reason to alter that view.

Œnothera is by no means the only genus in which the observations lead naturally to a telosynaptic conclusion. In *Lathyrus*, Dr. Latter[2] has shown that the evidence of telosynapsis is very clear, and no fair treatment of her observations can twist them into a parasynaptic interpretation. The spireme is shown from a remarkably early stage in the heterotypic prophase to be a continuous single thread, which gradually shortens and thickens and becomes arranged in a characteristic way, with seven loops radiating from the centre. Each loop clearly represents a pair of chromosomes attached end to end. A parasynaptic interpretation is not only contrary to all her observations, but also would involve as well the disruption of the individuality of every chromosome at this period.

This is not the place to discuss cytological details, but Darlington has referred to the work of two of my pupils, and a word is necessary on this subject. Any one who reads the papers of Dr. Sheffield,[3] only one of which was referred to by Darlington, and examines her drawings, will recognise the very high quality of her technique, and the cogency of the evidence for telosynapsis in the forms she has studied. Her results need no defence from me. For example, in the segmented spireme stage the connexions between the chromosomes are sometimes short and sometimes very long, yet they are invariably single; but on Darling

ton's hypothesis they should be double, as he finds them to be in *Tradescantia* and other forms

Catcheside's very interesting case[4] of a triploid *Œnothera* with its 21 chromosomes all arranged end to end in the spireme to form a closed ring is, if correct, a fatal blow to Darlington's theories as applied to *Œnothera*, as he has admitted Having admitted so much, he now denies the facts, but Mr Catcheside's preparations have been examined by other cytologists besides myself, and we were agreed that his interpretation is correct, although the evidence is not, perhaps, so copious as one would like Moreover, the usual distribution of the chromosomes as 10 + 11 in the reduction division, which I first showed in 1909[5] and Catcheside has recently confirmed is the result which would be expected from a ring of 21 linked chromosomes with successive members oriented towards opposite poles The early conclusion of mine[5] which Darlington quotes, "that there is usually no meta phase, strictly speaking", in *Œnothera*, has been abundantly confirmed by the work of many subsequent investigators, the zigzag arrangement of the chromosomes at this time being in marked contrast to their usual alinement

Cleland (who has also described telosynapsis in many *Œnothera* forms) and Blakeslee[6] have recently shown that the rings of chromosomes in many *Œnothera* species have a possible explanation on the basis of segmental interchange according to Blakeslee and Belling's hypothesis for *Datura* While such comparisons are to be welcomed as representing a possible advance, there are, nevertheless, important differences between the two genera, and in any case in recent years there has been evidence to suggest (in such papers as that of Latter on *Lathyrus*) that segmental interchange can also take place in connexion with telosynapsis and not merely as the result of lateral pairing of threads Blakeslee and Belling's hypothesis of segmental interchange is therefore quite independent of parasynapsis, and there is no reason why its occurrence in *Œnothera* should be regarded as an indication of lateral pairing

Whether my work on *Œnothera* during the last twenty years and more has been "sterile" can safely be left to others to judge Those who wish to form an unbiased opinion should read Lehmann's "Die Theorien der Œnotheraforschung" (Fischer, 1922), which deals with the whole subject up to 1922 They will then be able to realise the important part which the cytological investigations of *Œnothera* have played in the history of genetics A more recent monograph (Gates, 1928[7]) deals also with some of the later work My first critical paper on the subject[8] showed a telosynaptic course of events, contrary to my anticipations at that time, and of the scores of papers on the subject published since, every critical one has repeated the same story in all essentials, though with varying details and additional facts Especially has the constancy of chromosome linkages been brought out in recent years Various parasynaptists have endeavoured to make the facts fit into their ideas, but without conspicuous success Notably the Gregoire school have investigated *Œnothera*,[9] but failed completely to find evidence of parasynapsis They could only repeat in its essentials the telosynaptic account Recently Weier[10] has made another attempt But anyone who examines his figures, for example, Figs 18 22 and 36 39, will see that the special method of fixation which he recommends has been anything but a success, with the result that the chromatin has flowed together to form what he calls the "central coagulum", which is obviously not a natural condition

The idea that all organisms must conform to one scheme of pairing has seriously retarded progress in this field There are signs that some of the younger cytologists are developing less stereotyped ideas on this subject

R RUGGLES GATES

King's College,
London, May 19

[1] Gates *Bot Gaz* **51**, 321
[2] *Annals of Botany* **40** 277
[3] *Ibid* **41**, 799 *Proc Roy Soc* **105** 207 also Gates and Sheffield, *Proc Roy Soc* **105** 499
[4] *Trans Roy Soc Edin*, **56**, 467
[5] *Bot Gaz* **48**, 179, 1909
[6] *Proc Nat Acad Sci* **16**, 1930
[7] *Bibliographia Genetica*, **4**, 401 492
[8] *Bot Gaz* **46**, 1 1908
[9] See Vancanover *La Cellule* **37** 203 225 1927
[10] *La Cellule* **39** 271 1930

Interpretation of Infra-Red Frequencies of the Diamond

NATURE of May 10 contains two interesting communications one by Robertson and Fox and another by Ramaswamy—on the infra red frequencies of the diamond as determined directly and as inferred from the Raman effect With the view of interpreting these lines, it appears to me to be of interest that attention be directed to the following facts

Some time ago (*Sitzungsberichte der Preuss Akad der Wiss*, **33**, 447, 1926), from an analysis of the change of the specific heat with temperature, I had concluded that the atoms of a number of crystallised substances are capable of assuming two states differing in energy to so small an extent that the higher quantum state is excited thermally at comparatively low temperatures The diamond is one of these substances Formerly, the attempt was made to interpret its specific heat with the help of a Debye function of $\theta = 1860$, but now a much better agreement with the experimental results is found by means of a Debye function of $\theta = 2340$ and the supposition that the C atoms can assume two states differing in energy by 2120 calories per mol

If we therefore desire to compare the infra red lines with the thermal data, we must consider not only the altered frequency but also the possibility that the higher quantum state can be excited by light From the above mentioned energy difference a wave length of 13 4 μ can be calculated (experimental error about 10 per cent) Reinkober has, in fact, found an absorption band at 14 μ Now Ramaswamy believes he has discovered a diffuse band which can be calculated to correspond to a wave length of about 15 16 μ Taking the experimental error into account, which may be considerable in these Raman measurements, it is quite possible that this diffuse band is due to the transition to the higher quantum state brought about by the action of light Whether this is actually the case could be determined first by a more accurate determination and discussion of the infra red bands, and in the second place by determining the variation of the intensity of the lines with temperature, for which a perfectly definite course would be prescribed by the above mentioned interpretation

I may mention that the existence of an X ray reflection from the 222 plane of the diamond may be connected with these two energy states of the C atom, and moreover that, in the case of silicon and grey tin, both having the same crystal structure as the diamond, the specific heats point very definitely to the same phenomenon

F SIMON

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May 24

Scattering of X-Rays by Bound Electrons

THOUGH Bergen Davis and his collaborators (*Phys Rev*, 23) have reported the detection by means of an ionisation chamber of the modified lines (over and above the Compton effect) produced by the scattering of a monochromatic beam of X rays by carbon in a direction at right angles to the direction of propagation, Coster (NATURE, Aug 10, 1929), Ehrenberg (*Zeit f Phys*, 53), and Kast (*Zeit f Phys*, 58) have failed to observe the same on the photographic plate In a previous note to NATURE, it has been pointed out by me that a portion of copper $K\alpha$ radiation in passing through carbon decreases its frequency by an amount equal to that of the $K\alpha$ radiation of carbon The accompanying photograph (Fig 1) shows the effect of copper $K\alpha$ radiation in passing through carbon, nitrogen, and oxygen The known lines are marked as usual, while the new ones are shown by numbers The white mark on the copper $K\alpha$ line is due to the fact that a piece of aluminium was placed just in front of the photographic plate to decrease the blackness of the plate in this region

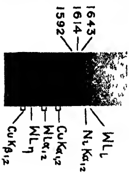

FIG 1

The lines are diffuse and very broad, and as such they could only be measured with a glass scale Longer exposure does not improve the relative intensity of these lines, as the general radiation tends to blacken the whole plate The three lines 1592 X U, 1614 X U, and 1643 X U are interpreted as due to the scattering of copper $K\alpha$ radiation by carbon, nitrogen, and oxygen The frequency differences (ν/R) between the copper $K\alpha$ radiation and these lines are 20 1, 27 6, and 37 7 respectively, whereas the frequencies (ν/R) of the $K\alpha$ radiations of carbon nitrogen, and oxygen are 20 4, 28 7, and 38 3 respectively

Similarly, a portion of the nickel $K\alpha$ radiation in passing through carbon and nitrogen shows new lines the wave lengths of which are 1719 X U and 1746 X U, and the frequency differences between the nickel $K\alpha$ radiation and these lines are 20 0 and 28 1 respectively

The absence of any modified lines by scattering (Coster, Ehrenberg, and Kast) in any other direction than that of propagation suggests that in all probability *in an interaction between a quantum and a bound electron*, the former on its passage through the medium loses a part of its energy and an equivalent amount of momentum in raising the electron from one orbit to the other, and is propagated in the original direction as a modified wave of lower frequency

B B RAY
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Fluorescence of Mercury Vapour in the Far Ultra-Violet

SOME years ago one of us (Terenin *Zeits f Physik*, 31, p 40, 1925) observed a strong re emission of the aluminium line at 1854 A in the fluorescent spectrum of dense mercury vapour excited by an aluminium spark A great deal of work has been done since on mercury band fluorescence, but this re emission has not been recorded again This can be explained by the strong absorption of the radiation in ordinary spectrographs with thick quartz and a long light path in air, a very small home made fluorite spectrograph was used in the experiment mentioned Last year this subject was re examined by us in more detail The part played by absorption was shown clearly by the fact that an exposure of five hours was needed to record the emission with an ordinary small quartz spectrograph, whereas five minutes sufficed with the fluorite one In spite of the short focal length of the lenses (5 cm) the dispersion of the fluorite prism was sufficient to show the aluminium lines at 1854 A and 1862 A clearly resolved

Re emission of the 1854 A line begins to be noticeable at a much smaller vapour density than is required for mercury band fluorescence in the nearer ultra violet and the visible At a vapour pressure of about 10 mm, the re emission is quite conspicuous On raising the pressure of the vapour, the aluminium lines at 1862 A, 1935 A, and 1990 A appear in succession, following the development of the well known continuous absorption band to the long wave length side of 1850 A There is in addition in the fluorescent spectrum a continuous background, which spreads with increase in vapour density from 1854 A to 2345 A, where it ceases abruptly A similar emission, likewise localised in the neighbourhood of the resonance line $1^1S_0 - 2^1P_1$ of the atom, has been observed in the case of cadmium by Kapuscinski (*Zeits f Physik*, 41, p 214, 1927) The remarkable re emission of exciting lines is no doubt of molecular origin, but its exact mechanism is still not clear

On heating the vapour to 800° C at constant pressure, the spectrum described above is quenched as a whole, which suggests a common origin for the re emitted lines and the continuous background

The presence of small traces of gases does not have the strong quenching effect which occurs with the near ultra violet and visible fluorescence This is consistent with the view that the state to which the molecule Hg_2 is raised by the absorption of the aluminium lines has a much shorter life than those responsible for the fluorescence in the near ultra-violet and visible, the duration of the latter has been shown to be of the order of 10^{-3} sec (Rayleigh, *Proc Roy Soc*, 114, 620, 1927 Pringsheim and Terenin, *Zeits f Physik*, 47, p 330, 1928) It is of interest that the band at 2345 A (probably corresponding to the 2^3P_2 state of mercury) is strongly quenched by traces of gases, and so does not seem to be connected with the far ultra violet fluorescence studied here

A quantitative investigation of the subject is in progress

M ELIASHEVICH
A TERENIN
Physical Institute,
University of Leningrad, May 1

The Acquired Characters of *Alytes*

IN NATURE of April 12, p 562, Dr Charles Walker draws a parallel between the well known experiments on plants transferred to other climate or soil and Kammerer's endeavours to prove the inheritance of acquired characteristics, especially in *Alytes obstetricans* Without again entering into the whole matter, I would only like to point out that Kammerer (*Roux' Archiv*, 45, 324, 1919) states distinctly that the *Alytes* returned to their habitual temperature retained the *habit* acquired at the high temperature artificially employed of copulating in the water (p 328), and that the fourth generation of *Alytes* which were returned to normal conditions developed the nuptial pad in a male of the F_4 generation It is the *habit* which was

induced and retained after return to normal climate The deprivation of water proposed by Walker would not have been equivalent to a return to former conditions, but induction in the opposite direction Furthermore, Kammerer himself did not think the nuptial pad of *Alytes* an example of a newly acquired characteristic, but suggested that the character had been inherited from the frog ancestors, which normally have these pads (p 326) In his English account entitled "The Inheritance of Acquired Characteristics" (New York, Boni and Liveright, 1924), Kammerer writes (p 6) on the pads of *Alytes* 'admittedly an atavism and not a new acquisition" He would not have opposed Walker's statement that *Alytes* had both potencies either to develop or not to develop the nuptial pad, one or the other turning up under certain external conditions Valentin Haecker has termed this 'pluripotency" ("Pluripotenzerscheinungen, synthetische Beiträge zur Vererbungs und Abstammungslehre Jena, Fischer, 1925)

Lastly, I must mention the great difference of method in the old experiments on plants and Kammerer's experiments on the transmission of acquired characteristics in those other cases, in which not only a habit, but also a morphological or colour character was immediately affected Whereas the plants were put back under the former conditions, Kammerer placed the progenies of animals modified by diverging external factors into an intermediate surrounding, thus avoiding the instantaneous counteraction of one modification by the opposite one The difference of these progenies in the same surroundings was taken as proof of the transmission of the induced modifications Returning to the case of *Alytes*, we have in the same surroundings the progeny of parents which have always been kept at normal low temperatures and breeding on land, and the progeny of those exposed for several generations to high temperature in water As in Kammerer's other experiments on the transmission of modifications, we have *different* characters in the *same* surroundings whereas in the experiments on plants referred to by Dr Walker, there were *different* characters in *different* surroundings, and only a small divergence in time of growth marked the origin of two lots side by side in the old conditions A comparison of the two lines of experiment can, I think, only be made in so far that both have furnished cases of 'pluripotency' HANS PRZIBRAM

Vivarium, Prater, Vienna, II,
May 2

Evolution of the Hive-bee

IT has been recently suggested, or maintained, that the case of the worker bee can be explained on the principles of genetics and mutation, but not on the Lamarckian hypothesis The queen bee or fully developed female shows no maternal or industrial instincts, but she transmits such instincts to her daughters, the worker bees, which are sexually undeveloped females

The question then is whether the absence of the above instincts in the queen bee is due to mutation, or to disuse It can scarcely be disputed that the hive bee is descended from a form like the humble bee or wasp in which a solitary fertilised female begins the summer by laying eggs, collecting food, making cells, and nursing the larvæ, and ends by resigning all these tasks to her sexually imperfect daughters The fact that the worker bee possesses and exhibits the industrial and maternal instincts is proof that it has inherited the genes of these instincts from its mother, the queen bee But if the absence of the same instincts in the queen bee was due to mutation, she must have lost the genes of those instincts, and the worker bee could not inherit them Even if we suppose that the mutation was only a modification of the genes which prevented them becoming active, this modification would be passed on by heredity to the worker

On the other hand, on the hypothesis that the loss of the instincts in the queen bee is due to many generations of disuse it is easy to explain their presence and activity in the worker For the suppression of the instincts will be impressed on the genes in association with the hormones present when it took place, namely, the hormones of the fully developed female reproductive organs The workers will inherit the genes with the same modification, and as in them the reproductive system is never fully developed or active, the modification will never show itself, and the instincts will be in full activity

The difference between the queen and the worker bee is thus of the same kind as that between a male with secondary sexual characters and a female in which they are suppressed by the absence of the testis hormone, and I have not yet heard any explanation of the origin of the influence of sexual hormones on the development of secondary sexual characters on the theory of mutations J T CUNNINGHAM

Chiswick, April 29

Science and Philosophy A Proposed International Conference

THAT great and epoch making work of Eddington, "The Nature of the Physical World," must have raised afresh in many minds the ever recurring question of the nature and meaning of science and its relation to philosophy and to our ordinary concepts of the familiar world Many eminent men of science and philosophy have dealt with this age long question in relatively recent times One might, for example, cite Comte, Clifford, Huxley, Spencer, Balfour, Stallo, Mach, Ostwald, Pearson, Poincaré, Alexander, and Bergson The rapidly advancing tide of scientific research during the last twenty five years has made the question still more urgent, although it has been frequently discussed and illuminated by many acute minds of the highest quality To mention again only a few examples, the names of Russell, Whitehead, Eddington, Jeans, Perrin, Rignano, Smuts, Einstein, Minkowski, Weyl, Heisenberg, de Sitter, Henderson, Morgan, Campbell, Lewis, Bridgman, and Ritter will occur to everyone

My proposal is that poets, philosophers, psychologists, biologists, mathematicians physicists, and chemists should be brought together to discuss this matter and, if possible, to elucidate it There is urgent need to bring such men together and to do something towards a synthesis of thought and the advancement of a true *philosophie scientifique* Perhaps the meeting of the British Association in 1931 might offer a possible occasion Another possibility would be a meeting in Italy in celebration of the memory of Prof Eugenio Rignano, who by his own writings and his editorship of *Scientia* did so much in the cause of scientific synthesis

The ideal would perhaps be a special international meeting held, say, every five years I believe very firmly that if the intellectual leaders of the world could meet at regular intervals and explain to each other, to their immediate audience, and to the world at large, their doubts and hopes concerning what the human mind has created from the data of sense the cause of civilisation would be materially aided

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Do Cockroaches eat Bed Bugs?

Howlett, writing on bed bugs in Lefroy's book on "Indian Insect Life", states "In America cockroaches and small red ants are mentioned by Marlatt (*U S Ent Circular*, No 47) as being fond of eating bugs, the ants in particular being effective checks" In the account of cockroaches, however, Lefroy himself writes, "these insects are 'scavengers', and *none is known to feed on living plant tissue or to attack living insects*" In view of the contradictory nature of the two statements, my experience with these insects at Bombay is perhaps worth recording

(1) It was observed that cockroaches generally frequented bug infested bedsteads at night, although they were sometimes seen under the mattresses in the daytime also

(2) The presence of cockroaches in very large numbers on a bug infested cot was once noted to be associated with the complete disappearance of bugs, in a fortnight, after the cot was discarded from use

In order to exclude alternative explanations for the presence of cockroaches and disappearance of bed bugs in the second case, direct experimental evidence was sought to discover if the cockroaches were really capable of eating bed bugs Cockroaches were kept singly with one or more living bed bugs, in glass jars, each guarded at the mouth by a fine piece of muslin, tightly tied by means of a string It was found that at least *Periplaneta americana* ate bed bugs, but preferably those young ones which had soft blood gorged abdomens Adult bugs with comparatively harder exoskeleton were sometimes rejected The maximum number of bed bugs eaten by a cockroach was three out of twelve supplied to it in forty eight hours, after which, during the following twenty four hours, the cockroach preferred to starve The repetition of the above experiments confirmed Marlatt's observation that cockroaches of this species will eat bed bugs

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April 18

Band Spectrum of Sulphur

The absorption spectrum of S_2 vapour has been investigated by Henri and his pupils (Nature, **114**, 894, 1924, *C R*, **179**, 1156, 1924, *Jour de phys*, **8**, 289 1927) and by Rosen (*Zeit f Phys*, **43**, 69, 1927, **48**, 545, 1928) They found a band system leading from the vibrational levels of the normal electronic state of the molecule to the vibrational levels of an excited electronic state They also found that those bands for which the upper states lie above a certain energy value are diffuse, a fact which can be explained if one assumes that in these states the molecule has the possibility of dissociating spontaneously into separate atoms, a phenomenon called predissociation by Henri (see, for example, Kronig, *Zeit f Phys*, **50**, 347, 1928)

At the suggestion of Dr Kronig, I investigated the spectra obtained by passing a high voltage discharge through hydrogen sulphide at a pressure of a few millimetres It showed that the same band system obtained by the observers mentioned above in absorption appeared here in emission, with the one difference that the bands which in their investigations were diffuse are here entirely absent After the current had been passed through the discharge tube for some time, a deposit of sulphur appeared on the walls

These facts can be understood if it be remembered that the S_2 molecules produced by the discharge and raised to the levels in question have a very short lifetime They will hence dissociate before they have a chance to fall back to the normal state under emission of radiation, so that the emission bands starting from them are very faint or entirely absent

Besides the band system just discussed, the photographic plates showed another band system with its maximum intensity in the region of 2570 A To judge from its appearance, it is also due to S_2 It is hoped to investigate in greater detail the structure of these bands, particularly with regard to a possible intensity alternation

H H Van Iddekinge

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May 9

Water-meadows and River-flow

I am glad to see from Dr Vaughan Cornish's review on pp 737 8 of Nature for May 17 that the Council for the Preservation of Rural England is directing attention to the unsuitability of water meadows for dwellings and to the fact that they serve as safety overflows for inhabited districts lower down the river in times of heavy flooding The æsthetic advantage of these flats is also accentuated

A point which does not seem to have been made is that water meadows are essential for the existence of the river itself If recent proposals for measures to ensure the rapid passage seaward of winter rainfall are adopted the summer flow of such rivers as the Thames is likely to become negligible In winter as much as 10 000 million gallons may pass over Teddington Weir in twenty four hours, in summer as little as 100 million gallons If the water now stored in the land around the upper reaches during winter floods is not allowed to collect in the future, then it is difficult to see how the summer flow can be maintained even at its present level or how flooding near London can be prevented in winter The question affects navigation, sewage treatment, and water supply not only in the Thames but also in all such rivers Lord Desborough has directed attention to the doubtful future of the water supply of many districts

J H Coste

Teddington, May 23

Flint Implements of Lower Palæolithic Age from the Mammaliferous Gravels of Yorkshire

On Feb 15 last there appeared in Nature the announcement of my discovery in Yorkshire of Upper Palæolithic implements, *in situ*, at the base of a glacial deposit of Pleistocene age

Messrs Dewey and Bromehead, of H M Geological Survey, have just completed an official examination of the sites under consideration, and, from the sections north of Bridlington, they have removed, with their own hands, numerous implements from the base of what they, also, consider to be a deposit of late Pleistocene age A detailed report of these investigations will be issued in due course

On Saturday, May 17, whilst examining, in their company, the mammaliferous gravels at Burstwick, in Holderness, I recovered therefrom a Levallois-flake, which, from its stratigraphical position, cannot be later in date than the Early Mousterian period Last year, I found in this same deposit a small hand axe, flaked on one face only, both these specimens will be described and figured at a later date

J P T Burchell

30 Southwick Street,
Hyde Park, W 2, May 19

The Metallography of some Ancient Egyptian Implements *

By SIR HAROLD CARPENTER, F R S, and DR J M ROBERTSON

IRON in ancient Egypt has been the subject of many publications, and, concerning such aspects as the approximate date of the beginning of the Iron Age, the use of meteoritic iron, and the source of the Egyptians' knowledge of iron making, many different opinions have been expressed With regard to some of these questions the position is such that evidence may be adduced in support of a variety of views each of which is at variance with certain portions of the total available evidence Concerning the approximate date of the beginning of the Iron Age there are, for example, two main categories of evidence, the direct and the indirect, and generally speaking, the conclusion arrived at depends on which type is regarded as the more reliable The evidence provided by the discoveries of iron articles, iron smelting furnaces, or references to iron in writings or paintings constitutes the direct evidence, whereas the existence of hard stone carvings which would appear to have required the use of iron tools in their execution constitutes the indirect evidence

Only six iron specimens which can be definitely shown to belong to the period 1300 B C have been found, whereas iron articles belonging to later periods are fairly plentiful On the basis of this evidence, Petrie has suggested that iron did not come into general use in Egypt until 1300–1200 B C, although it was apparently used sporadically for a period of from 2000 to 3000 years before this

A further indication of the late beginning of the use of iron is provided by the evidence quoted by Rickard,[1] that mural pictures surviving from the period prior to 2000 B C show weapons coloured yellow or red, representing copper or bronze, but none of iron, which was usually coloured blue in paintings subsequent to 1500 B C In the long lists of tribute collected in the days of the Eighteenth Dynasty (1580–1350 B C) iron is not mentioned, and Rameses II (1292–1225 B C) wrote to the King of the Hittites asking for a dagger In the innermost sarcophagus of Tut ankh amen, who died about 1360 B C, three iron articles were found—a dagger blade, part of an amuletic bracelet, and a miniature head rest Rickard infers from the position of these articles, which lay on the wrappings of the mummy, that they were the most precious things belonging to the dead Pharaoh, and that the iron was more rare and highly prized than the gold of which the sarcophagus was made Among the funerary chattels found in the annexe of Tut ankh amen's tomb were some miniature iron implements, and Howard Carter[2] suggests that these might have been "gifts to the young King to record the arrival or discovery of iron in Egypt"

All the foregoing evidence goes to show that iron, although not unknown in Egypt before 1200 B C, was very rare, and was probably not manufactured in that country The majority of archæologists accept this evidence as conclusive

If no appreciable quantity of iron existed in Egypt before 1200 B C, copper and bronze tools must have been the only ones available, and yet from the Fourth Dynasty (2900 B C) the Egyptians were accustomed to sculpture hard stones, such as granite and diorite According to Garland and Bannister,[3] "Many of the antique Egyptian statues are perfect examples of the sculpture's art, the hardest stones were carved and shaped with unfailing accuracy, faultless symmetry and definition sharp corners with perfect angles and knife like edges, gracefully curved and plumb straight lines, grooves and serrations deep and shallow depressions and reliefs, with delicate, undulating contours, or rigidly plane surfaces"

Sculpture work of this kind is known to have been done for a thousand years before the introduction of bronze, when copper tools only were available—but even with bronze tools it is difficult to understand how this work was accomplished The hypothesis that the Egyptians possessed some secret method of hardening copper has now been discarded, and two alternative explanations of their method of carving hard stone remain One, due to Petrie, is that the work was done by means of emery fed copper or bronze tools, the other, that steel tools were used Hadfield[4] goes so far as to suggest that "the ancient Egyptians were not only able to make steel for tools of all kinds, but also to cement and harden it, or, if not themselves steel workers, they obtained the necessary material and help from the workmen of another nation"

The existence of the hard stone carvings is difficult to reconcile with the evidence of the specimens found by excavators The scarcity of iron relics of the period prior to 1200 B C may perhaps be explained by corrosion, by the existence of a superstitious objection to the inclusion of iron among funerary objects, or by arguing that the total number of metal specimens found is at best only a small proportion of those that must have been used These arguments may, however, be met by appealing to the permanency of iron rust, and to the fact that many iron objects belonging to the period subsequent to 1200 B C have been found in tombs and elsewhere

We incline to the view that iron was rare in Egypt until about 1300 B C, for the evidence of this scarcity implied in the request of Rameses II to the King of the Hittites, and in the nature and position of the iron objects buried with Tut ankh amen, is certainly strong

The existence of a number of iron specimens definitely known to belong to the period 2900–1450 B C shows, however, that the Egyptians were acquainted with this metal for about fifteen hundred years before its use became general During this, what may be termed, sporadic Iron Age, it was

* Based upon a paper read on May 1 at the annual meeting of the Iron and Steel Institute

obtained in limited quantities either by home manufacture or by trade, and it has been argued that an intelligent people like the Egyptians would not have been content with a limited supply of this valuable commodity, but would have applied themselves to extending its production and manufacture The validity of this argument rests, however, on the assumption that the iron was found to be superior, at any rate in certain respects, to copper and bronze, in the working of which the Egyptians had already acquired remarkable skill On consideration it is quite clear, however, that the first efforts at iron making would be most unlikely to produce a metal which would commend itself to the Egyptians or any other ancient people previously acquainted with the use of bronze

We are liable to forget that the position of iron in modern civilisation is due to the abundance of its ores, the scale on which it can be manufactured, and the variety of alloys it forms with carbon None of these considerations would influence its position when it first appeared in Egypt The spongy mass of iron and slag obtained from the direct furnace required much heating and hammering to get rid of the slag and produce a coherent metallic lump From this material the desired articles would have to be laboriously cut and forged with frequent reheatings, and the final product—if free from carbon, as most direct iron was—would be softer than bronze, devoid of ornamental attributes, and liable to rust The manufacture of iron articles was therefore much more troublesome than that of similar articles in bronze, and when finished, the product would not display any properties superior to those of this alloy It is probable, therefore, that iron when first discovered was developed with most avidity among people not previously acquainted with other metals or not highly skilled in their use In Egypt conditions were far otherwise, and iron would probably be regarded as a curiosity, or something with possibilities, but not as an alternative to, or an improvement on, existing metals

The position of iron in ancient Egypt clearly did not depend entirely on acquaintance with the metal, the ores from which it could be extracted, and the means by which this could be accomplished Numerous other considerations have to be taken into account, and these may be summarised by stating that direct iron when compared with bronze did not possess sufficient advantages to compensate for the greater difficulty experienced in manufacturing useful articles

The usefulness of iron for tools, weapons, and implements of all kinds would be greatly enhanced when means were discovered for converting it into *steel* by the introduction of carbon and a further extension of the utility of this metal would follow the discovery of quenching With the development of these processes of carburising and quenching, iron, because of the *increased* hardness that could then be conferred on it, would assume a new significance, and it was probably from this time that it began to be taken seriously and the sporadic gave place to the real Iron Age

Although there is in existence a large collection of ancient specimens of iron, comparatively few of them have been examined by metallurgical methods, and this is largely due to the reluctance of archæologists to submit specimens for examination when they anticipate that this will involve their partial destruction It is certainly true that examination by chemical methods requires drillings to be taken, but microscopic examination can be carried out simply by polishing a part of the surface, and by this method a considerable amount of information can be obtained from the examination of ancient metal specimens without injuring them

FIG 1 —Specimen No 6, a chisel

Through the kindness of Sir Flinders Petrie, we have been able to examine nine representative specimens selected with his assistance from his Egyptian Collection at University College, London The specimens examined were as follows —

No 1 A portion of a sickle This specimen had been very badly corroded, and consisted mainly of iron oxide held together by a thin sheet of metal The sickle consisted of two parts, a back and a blade Sir Flinders Petrie considers that this specimen belonged to the Roman period, and was probably made in the second or third century A D

No 2 A small knife in good condition It is considered that this belonged to an early period in the Iron Age, and was probably made about 1200 B C

No 3 A knife with a bronze handle This specimen was in fairly good condition, although it showed marked surface corrosion and pitting It is regarded as belonging to the period about 1200 B C

No 4 A small knife in good condition It is not an Egyptian shape, and is believed to have been imported from Europe about 300 B C

No 5 This specimen is a very primitive piece of work, and it is difficult to say what it is Sir Flinders Petrie was unable to assign it to any period

No 6 A chisel in good condition (Fig 1) It is supposed to date from about 700 B C

No 7 A hoe in good condition This specimen is supposed to date from about 800 B C

No 8 An axe head, corroded It is believed to date from about 900 B C

No 9 An axe head in very good condition (Fig 2) This specimen is believed to belong to the same period as No 8, namely, about 900 B C

The examination of these specimens was carried out in such a way that practically no damage was done to them In each specimen a representative

area was polished and examined microscopically, micrographs being taken of typical structures The hardness of these typical structures was then determined by means of a Brinell hardness tester with a 1 mm diameter ball In all the specimens extensive variations in microstructure were observed Some of these were clearly the result of carburising and heat treatment, but others were due to variations in the composition of the original metal, which when produced in primitive smelting furnaces consists of particles that have been welded and not melted together

FIG 2—Specimen No 9 an axe head

The principal results that were obtained from examination of the specimens were, briefly, as follow —

No 1 This sickle consisted of two portions, a back and a blade Microscopic examination showed that the back consisted mainly of ferrite with a little carbide, indicating that it had been made from iron containing a very small proportion of carbon The blade, however, had been carburised so as to bring the carbon content up to about 0 35 per cent It had then been quenched in water and tempered at about 600° C (Fig 3)

No 2 This specimen, presumably made in the first place from almost pure iron, had been carburised so that the carbon content was raised to about 0 7 per cent at the edge From the edge towards the back the carbon content decreased progressively, and the microstructure and hardness varied accordingly After carburising, this knife had been heated to about 750° C and air cooled—thus producing a hardness of 269 Brinell at the edge

No 3 This specimen had been given a similar treatment to No 2, and the variations in microstructure were almost identical

No 4 This specimen had not been carburised or subjected to any other special heat treatment It was a double edged knife or dagger, and, whereas the middle of the blade was small grained and contained a fair amount of carbon, the edges were large grained and consisted of soft ferrite The hardness of the middle of the knife varied between 137 and 143 Brinell, that of the edges varied between 95 and 107 Brinell

No 5 This specimen contained a small amount of carbon and had been water quenched, thus producing a hardness which varied between 160 and 197 Brinell

No 6 This chisel had been carburised so as to produce a carbon gradient which varied from about 0 6 to 0 8 per cent at the edge to about 0 15 per cent $1\frac{1}{4}$ in from the edge It had then been heated at the edge and quenched by immersing the edge only

No 7 This hoe had been forged from direct iron and had received no further treatment

No 8 This axe head was badly corroded It had been carburised, but the treatment had not produced the highest carbon content at the edge It had then been quenched, but the original hard edge had evidently been removed by sharpening The highest hardness number obtained was 229 Brinell in an area of high carbon at some distance from the edge, the hardness at the edge was 207 Brinell

No 9 This axe head appeared never to have been used and was still protected by a blue film of oxide formed during the last heat treatment For this reason it had not been corroded and the edge was sharp and regular The carburising treatment had produced a carbon content of about 0 9 per cent at the edge, decreasing to a very small amount at 1 in from the edge Quenching the edge had resulted in the production of a hardness of 444 Brinell at the edge and a progressive decrease in hardness to 62 Brinell at 1 in from the edge

It is evident from the examination of these nine specimens that although the Egyptian process of extracting iron from its ores was very primitive and resulted in the production of almost pure iron containing some slag, yet the metal workers of the period were able to produce in small articles a great variety of properties by means of carburising and heat treatment All the articles examined do not show the same degree of skill in their manufacture

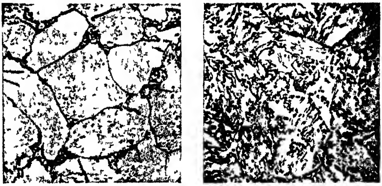

FIG 3—Specimen No 1, (a) back, (b) blade ×820

and heat treatment, even when they are considered according to their age But even at the present time there are notable differences in the extent to which the metallurgical knowledge and skill of the community is exhibited by different products, and the same would certainly hold in ancient Egypt when the facilities for the spread of knowledge were, by comparison, very meagre

So far as we know, the facts disclosed by the present work constitute the first definite evidence that carburising, quenching, and the advantages of heat treatment generally, were known and understood many centuries before the Christian era Hitherto, the earliest direct evidence of hardening has been that provided by Hanemann,[5] who observed a hardened structure at the edge of a specimen found during the excavations on the site of Steinsburg at Romhild in Thuringen This specimen belonged to a period about the beginning of the Christian era Indirect evidence of quenching at a much earlier date is provided by a reference in Homer

As already stated, the introduction of carburising and quenching would entirely alter the position of iron in comparison with bronze, and in our opinion it is probable that the Iron Age in Egypt did not properly begin until these processes were understood In other words, it was not until iron had been converted into steel that the Egyptians obtained a range of alloys which were superior in properties to bronze and capable of more varied applications In countries, however, where bronze was practically unknown, where notable skill in its manipulation had not been attained, or where the requisite ores were not readily available, the extensive manufacture of iron would follow more closely on its first discovery

There is no reason to suppose that the specimens examined in the present work represent the earliest specimens to be carburised and quenched The investigation has shown, however, that these processes were in use in the period 1200–800 B C As it was about this time that iron came into common use in Egypt, the information now obtained provides a substantial argument in support of the view that the discovery of carburising and quenching was the cause of the extensive utilisation of iron

[1] T A Rickard *Journal of Iron and Steel Institute*, No II p 323, 1929

[2] Howard Carter *Illustrated London News*, July 2, 1928

[3] H Garland and C O Bannister Ancient Egypt Metallurgy (London, 1927)

[4] Sir Robert Hadfield *Journal of the Iron and Steel Institute*, No I p 134, 1912

[5] H Hanemann *International Journal of Metallography*, vol 4, p 248, 1913

Chinese and Malayan Medicine

IN his presidential address to the Chemical Section of the British Association last year, Prof G Barger pointed out that "the use of vegetable drugs led pharmacists to examine the constituents of plants and thus the foundations of descriptive biochemistry were laid" He suggested later on that 'whilst organic chemists are often eager to investigate the constitution of animal and vegetable substances, they are less ready to undertake the preliminaries of purification and isolation and are therefore less apt to discover new ones"

So far as Germany and Great Britain are concerned, it is probably true that less work is being done on the isolation of the proximate constituents of plants and that in France the additions to such knowledge are of a strictly limited character On the other hand, there is a distinct growth of such work in India, China, and Japan, and there are signs of a revival of interest in it in the United States The earlier British and German investigations of this kind were usually devoted to severely practical ends, such as the isolation of active principles from vegetable drugs or the preparation of colouring matters from natural dyestuffs, and it is just possible that the decline of interest is largely due to failure in supplies of new raw material worth examination Directors of laboratories associated with the application of chemistry to medicine are apt to be afflicted by enthusiastic and credulous collectors of native drugs, who bring home an ounce or two of mouldy roots and a romantic story of marvellous cures of diabetes, tuberculosis, or cancer, and expect the chemist to examine the one and believe the other

Much valuable work has been wasted in examining material of this kind Though there is still much to be done, we already have much information linking up the groups of the systematic botanist with particular types of chemical compounds, and there are already clear indications that in the future, work on the constituents of plants is likely to proceed on systematic lines to be settled by cooperation between the botanist and the chemist In this connexion it is satisfactory to find Dr Hooper employing his well earned leisure in identifying and recording the botanical sources of the drugs to be found in Chinese pharmacies in Malaya[1] The particular specimens identified were collected by Mr I H Burkill when Director of Gardens, Straits Settlements The number of specimens dealt with is 456, and they are mostly of plant origin The Chinese name of each drug is given, followed by the Romanised Mandarin transliteration The botanical source is then stated, whereever possible, and a note as to the composition, uses, etc, of the drug is added

Some of these substances were once familiar drugs in Europe, but have long been obsolete Many of them are still in common use in European medicine, for example, *Datura Metel*, the usual source of the valuable alkaloid hyoscine, *Hydnocarpus anthelmintica*, the seed oil of which is one of the raw materials used in preparing the derivatives of chaulmoogric and hydnocarpic acids used in the modern treatment of leprosy, rhubarb root, for supplies of which European druggists are still dependent upon Chinese collectors, and a considerable number of aromatic drugs and spices such as mint, anise, dill and ginger

The most interesting materials, however, are those which have not acquired fame in Europe, of which *Achyranthes bidentata* Blume is an example

Judging from Dr Hooper's note, the roots of this plant must be in fairly common use in China and Japan, where it is regarded as a cure for rheumatism, fever, and cutaneous diseases In Perak it is given for extreme anæmia, whilst in India and Ceylon the roots of the allied species, *A aspera*, have a reputation as a diuretic and astringent These two species belong to the natural order Amarantaceæ According to Wehmer ("Die Pflanzenstoffe") the chief economic distinction of the plants of this order appears to be that of furnishing a number of harmless and useful vegetables, whilst their most striking constituent is potassium nitrate

On the whole, therefore, it appears likely that the value of *A bidentata* in the various diseases referred to above rests on a somewhat slender foundation

A more plausible case can be made out for *Quisqualis indica*, the seeds of which enjoy a wide spread reputation as an anthelmintic, in which respect they resemble two other plants of the same natural order, Combretaceæ, namely, *Combretum quadrangulare* and *C pilosum*, neither of which occurs in Dr Hooper's list, though the first is used in Siam and the second in India Another species, *C sundaicum*, is believed to afford relief to the con firmed opium smoker suddenly deprived of his favourite drug All these plants have been ex amined at various times, and from none of them has anything likely to account for their alleged anthelmintic action been isolated, the most inter esting constituents so far as the *Combretum* spp are concerned being usually tannin or its degrada tion products or related substances Now that better methods of testing anthelmintics are being gradually worked out, it would be interesting to have some of these products tried by pharmacolo gists, as chemical methods of examination seem so far to have failed to justify native belief in their efficacy, unless, indeed, certain kinds of tannin prove to have hitherto unsuspected value as anthelmintics

We also owe to Mr Burkill's enthusiasm as a collector a monograph on the native medicines of Malaya [2] He and his colleague toured through the Peninsula interviewing the native physicians and midwives and inducing them to provide specimens of the drugs they used These, duly registered and numbered, have been placed in the herbarium of the Singapore Botanic Gardens The botanical identifications of these specimens, their Malay names, localities, and medicinal uses, are recorded in the monograph, which also includes an index to the vernacular names, with explanatory comments by the senior author

With regard to the medicinal uses it is explained that the Malays are apt to consider all sicknesses following childbirth as due to evil spirits and to place these in a special group called *sakit meroyan* To ward off such attacks they administer during the first three days after childbirth—the period during which evil spirits are most powerful—pre parations called *ubat meroyan*, and the word *meroyan* is introduced into the names of plants so used, often in highly fanciful expressions As the authors put it, an *ubat meroyan* may not be in- tended to have any immediate effect, and many of the plants in the class possess the medicinal value of sympathy, but none chemico physiologically

The number of drugs so used appears from the list to be very large These Malayan drugs include comparatively few that have found acceptance in European medicine, but many of them are well known as having a considerable reputation among natives in various parts of the world as specifics for certain tropical diseases Among these are *Quisqualis* and *Combretum* spp, the alleged anthelmintic properties of which have been referred to already Three *Alstonia* species are mentioned, including *A scholaris*, which is included in the British Pharmacopeia of 1914, apparently on account of its sup posed anti malarial action, but there is no allusion to this use in this monograph except possibly in the case of *A angustiloba* Miq, which is described as a cure for remittent fever', used by smearing the leaves with coconut oil, heating and applying hot over the spleen One of the Rubiaceæ, *Mitragyne speciosa*, is used for treating wounds, curing a craving for opium, eliminating worms in children, and reducing enlarged spleens, a truly beneficent plant, about which the authors unkindly remark that as a cure for opium craving the remedy is apparently worse than the disease This interesting plant has already been examined in Prof Barger's laboratory and it appears to merit further atten tion from the chemist and the pharmacologist

Many such examples of the value of botanical identifications as a guide to the chemist could be picked out of these useful publications, and from this point of view alone, Dr Hooper and Mr Burkill have rendered no small service in carrying out what must have been a difficult and sometimes tedious task

It is to Prof Bernard Read and his pupils in Peiping (Pekin) that we owe the introduction or if the reader prefers it, the reintroduction, of the alkaloid ephedrine into European medicine for the treatment of asthma, a piece of work which has made ephedrine in a short time one of the more important alkaloids of commerce and has led to numerous researches on the botany and chemistry of the genus [3] It is a curious fact that much of this scientific work and the resulting commercial organisation necessary for the collection of the *Ephedra* species for export to Europe and America for the manufacture of the alkaloid, have been accomplished while China has been undergoing violent political and military convulsions After much discussion it has apparently been clearly established that the two species chiefly collected in China as sources of ephedrine are *E sinica* Stapf and *E Equisetina* Bunge, and that to both of these, and possibly others, the vernacular name *Mahuang* is applied Both these species are fully described and illustrated by Prof Read, and the complicated story of their botanical identification is clearly related

There is still some doubt as to whether any of the commercial Chinese supplies are derived from *E distachya*, as Prof Read thinks there is good reason to believe this species occurs between the

Huang Ho and Yangtse Kiang Rivers, and Mr E M Holmes has had commercial material apparently derived from this source

It is a curious and disconcerting fact that when many plants of a genus have been examined, they quite frequently show remarkable differences in the character of their secondary constituents, such as alkaloids It is not surprising that five of the Chinese species, namely, *sinica*, *Equisetina*, *gerardiana*, *distachya*, and *intermedia* should contain both ephedrine and its isomeride pseudoephedrine, the former predominating in all but *intermedia*, or perhaps that E monosperma should contain a third alkaloid "Ephedrine, Spehr" and that these alkaloids should also occur in these species from India and Europe so far west as the Canaries, so far as they have been found there and examined It is, however, remarkable that of the Ephedras found in the two newer continents, America and Australia, none has so far been found to contain alkaloids Prof Read's monograph is a useful and timely summary of the present position of the botany of Ephedra, and particularly of those species which have acquired commercial importance Readers of NATURE do not need to be reminded of the valuable services which Kew renders to science and to industry, but it should be pointed out that, thanks to the work of Dr Stapf on Ephedras, Kew has been able to render very considerable assistance in solving the problems arising out of the introduction of this drug into commerce

T A H

[1] "On Chinese Medicine Drugs of Chinese Pharmacies in Malaya" By Dr David Hooper *The Gardens Bulletin* Straits Settlements, vol 6 part 1, December 1929 Price 2 50 dollars

[2] Malay Village Medicine Prescriptions collected by I H Burkill and Mohamed Haniff *Ibid* Vol 6 part 2 April 1930 Price 2 50 dollars

[3] Ephedra By Prof Bernard E Read professor of pharmacology Peiping Union Medical College Peiping China *Flora Sinensis*, Series B vol 24, part 1 1930

News and Views

THE King's birthday honours list contains the following names of scientific workers and others associated with scientific activities *Baron* The Right Hon Noel Edward Buxton, Minister of Agriculture and Fisheries *Baronets* Mr Basil Mott past president of the Institution of Civil Engineers, and Mr F H Royce, founder, director, and chief engineer of Rolls Royce, Limited *Order of Merit* Prof S Alexander, in recognition of his eminent position as a British philosopher and for his services as a writer and teacher *Knights* Dr E Brown, secretary of the National Poultry Council of England and Wales, Major T H Crozier Chief Inspector of Explosives, Home Office, Prof A S Eddington, Plumian professor of astronomy in the University of Cambridge, Prof Leonard F Hill, director of the Department of Applied Physiology, National Institute of Medical Research, Dr G A K Marshall, director of the Imperial Bureau of Entomology, Prof J Arthur Thomson, Regius professor of natural history in the University of Aberdeen, Mr H W A Watson, lately Chief Conservator of Forests, Burma, Mr H Wright, chairman of the Executive Committee of the Governing Body, Imperial College of Science and Technology, South Kensington *K B E* Sir Philip Hartog, chairman of the Education Committee Indian Statutory Commission *C B E* Dr E W Smith, honorary technical adviser to the Area Gas Supply Committee, Board of Trade *O B E* Mr T P W Barty, lecturer in civil engineering, Gordon College, Khartoum, and Municipal Engineer, Khartoum, Mr J A B Horsley, Electrical Inspector of Mines, Mines Department, Board of Trade, Prof W M Roberts, professor of mathematics, Royal Military Academy, Woolwich, Dr F B Young, Principal Scientific Officer, Admiralty Research Laboratory *M B E* Mr J Haworth, general manager of the Sewage Disposal Department and Chief Chemist and Water Examiner, Sheffield Corporation, Mr H W Jack, economic botanist, Agricultural Department, Straits Settlements and Federated Malay States, Mr H G D Rooke, lately Chief Locust Officer, Ministry of Irrigation and Agriculture, Iraq, Dr A Winstanley, Junior Inspector of Mines, Mines Department, Board of Trade *C I E* Mr F F R Channer, lately Chief Conservator of Forests, United Provinces, Lieut Col H R Dutton, lately Principal, Prince of Wales' Medical College, Patna, and Superintendent of the Patna Medical College Hospital, Bihar and Orissa, Mr L Mason lately Chief Forest Officer, Andamans, Mr R R Simpson, Chief Inspector of Mines in India *C V O* Mr Evelyn C Shaw, secretary since 1910 to the Royal Commissioners of the Exhibition of 1851 *I S O* Mr D Keiller, head laboratory assistant, Imperial Institute of Veterinary Research, Muktesar, United Provinces

THE President and Council of the Royal Society have recommended Mr Ramsay Macdonald and General J C Smuts for election into the Society under the special statute which permits the election of "persons who in their opinion either have rendered conspicuous service to the cause of Science, or are such that their election would be of signal benefit to the Society" It should here be said that the inclusion of certain persons not actually engaged in scientific pursuits is a practice sanctioned by long usage In the Society's original statutes of 1663, it was provided that every one of His Majesty's subjects having the title and place of baron, or any other higher title or place, and every one of His Majesty's Privy Council, might be elected In process of time, such persons formed a panel or privileged class However, in 1873, there was much discussion on a motion to require in the privileged class, "evidence of ascertained special power and disposition to forward the aims of the Society from exceptionally personal or official advantages of position" Arising therefrom, the privileged class was limited to princes of the blood royal and members of the Privy Council Statutes enacted in 1902 abolished the clause relating to privy councillors, and the basis of qualification remains now as quoted above Its implications seem clear enough The

opportunities of the chief officer of state in the scientific arena are always at hand, they have nothing to do with political complexities

IN connexion with Mr Macdonald's nomination for election, it is interesting to recall that within the past sixty years four precedents can be recorded for the election of a Prime Minister whilst holding the seals of office The instances are Mr Disraeli, elected on Feb 10, 1876, Mr Gladstone elected on Jan 13, 1881, Mr Asquith, elected Nov 5, 1908 Mr Baldwin, elected Nov 3, 1927 The first named signed the charter book, and was formally admitted by Dr J D Hooker, the president, on June 1, 1876—fifty four years ago—that also being the day fixed for the election of the fifteen ordinary fellows Amongst these (and happily still with us) was Prof H E Armstrong Mr Gladstone was admitted on May 19, 1881 (Mr Spottiswoode was president), on which occasion William Crookes read a paper, "On Discontinuous Phosphorescent Spectra in High Vacua" It fell to Mr Asquith, in 1912, as Prime Minister, to propose "The Royal Society" at the Guildhall banquet held in connexion with the two hundred and fiftieth anniversary of the Royal Society Mr Baldwin was formally admitted by Sir Ernest Rutherford, and a similar act when extended to Mr Macdonald (following election) will provide the circumstance (we think without precedent) of the admission of two Prime Ministers during one presidency The only Prime Ministers for more than half a century who have not been fellows of the Royal Society by special election or otherwise are Sir Henry Campbell Bannerman, Mr Lloyd George, and Mr Bonar Law

PROF A S Eve's recently delivered presidential address to the Royal Society of Canada, entitled "The Universe as a Whole", essays to unite in a single view recent discoveries and theories in the physical and biological sciences and gives point to the suggestions made in our leading article this week It is pointed out that, in spite of modern specialism, "many of the great advances to day are made by those who are fortunate and able enough to be expert in two subjects, for example, in physics and in physiology, or in mathematics and physics, or in physics and chemistry, or in physics and philosophy Borderlands are prolific" This seems to prove that the wider view is not always the more superficial, hence the value of such an inclusive conspectus as the one before us Prof Eve, in dealing with recent physical theories, observes that the new quantum mechanics constitute a "far greater *bouleversement*" than the principle of relativity, though the latter has attracted more public attention Another observation of interest is that the search for ultimate nature of *substance* is probably futile and may be safely abandoned Attention is now concentrated "on the *structure*, on the form, arrangement, and resulting habits or behaviour of things" "The appeal to models is passing away, and the trust in mathematical symbols, equations, and deductions is growing stronger"

PERHAPS the most interesting passage in Prof Eve's address is the following, which occurs under the heading *Time* 'It is a remarkable fact that in physics, energy has an intimate relation with time, and also with frequency so that it is a particular fad of the author to endeavour to ascertain to what extent we can substitute the frequency of waves for the perhaps less tangible but more familiar concept of energy This is scarcely the place to enlarge on this idea, and it must suffice to point out that, as Einstein explained gravitation on a geometrical basis, so it may be possible to consider energy more fully as an aspect of frequency, possibly arriving at a comprehensive wave theory of the Universe" Prof Eve makes the observation that "It is somewhat strange to think that if the whole human species were submerged in Lake Ontario the water would rise but a few inches and doubtless the Universe as a whole would go forward but slightly affected, and dynamically and materially unimpaired" This reflection leads to the thought of the eventual extinction of humanity upon this planet, and to the ultimate degradation of energy in the universe But Prof Eve is unwilling to believe that there can be no other alternative, and quotes the remark of Prof A N Whitehead that though the universe is physically descending, yet it may be spiritually ascending At any rate, upon a question which is far more obscure than it has been represented to be, one is entitled to suspect dogmatic statements

THE annual report of the British Science Guild recently issued records a year of considerable activity The Guild was invited to give the first evidence to be heard by the Board of Trade Patents Committee, 1929, which had been appointed as a result of its activities The evidence was presented by Dr W H Eccles, Major the Hon H Fletcher Moulton, and Mr A F Ravenshear A memorandum of evidence, supplementary to the report previously issued by the Guild, is to be found in the annual report A committee of the Guild is now discussing the position of the technical expert in the public service and in industry, and in this connexion it may be noted that the Guild protested vigorously at the entire absence of scientific and technical men from the present Royal Commission on the Civil Service Further, it proposes to offer evidence before this Commission, its spokesmen being Lieut Col W H D Clark, late Deputy Controller of the Patent Office, Sir Arthur Newsholme late Principal Medical Officer to the Local Government Board, and Lieut Col W A J O'Meara, late Engineer in Chief to the Post Office The Commission will therefore have an excellent opportunity of ascertaining some facts with regard to the loss of efficiency which arises from the subordination of those who have to those who lack expert knowledge of the work of technical Departments of State

DURING the past year the Guild instituted an annual lecture to be given in honour of a benefactor, the late Sir Alexander Pedler, in a provincial town The first of these lectures was delivered at Manchester by

Dr G C Simpson, director of the Meteorological Office (see NATURE, Dec 28, 1929, p 988) The next lecture will be given at Liverpool on Oct 22 by Sir David Prain, on the subject of "Science Discipline" The third edition of the Guild's "Catalogue of Scientific and Technical Books" is announced as in the Press It has been entirely revised and enlarged, and its publication will be welcomed by the many readers of scientific literature who have found the previous editions valuable Most scientific men welcome the work which the Guild is doing, but comparatively few seem to be willing to bear a small share of the burden by becoming members On the other hand, Sir Samuel Hoare, who succeeds Lord Melchett as president, may be counted upon to bring with him new and invigorating ideas for the Guild's sphere of usefulness The new honorary treasurer is Lady Lockyer, widow of Sir Norman Lockyer, founder of the Guild and of NATURE

WHILE the Government of Great Britain is still only at the point of considering whether the creation of one or more national parks is desirable and feasible, the announcement is made (by Science Service, Washington D C) that Poland is the latest nation to have developed a national park system The largest of the Polish parks is in the Tatra range, a part of the Carpathians on the Czechoslovakian boundary, and joining with reserved areas across the borders it contributes to form a great international park covering 240 square miles The wild creatures include bear, chamois, lynx, deer, and eagles To the Polish parks has also been added the former royal Russian hunting preserves in Bialowicza, a forest some 11 500 acres in extent which formerly sheltered one of the last herds of European bison The total land reserved in Poland at the present day, for recreational and educational purposes includes six national parks, 48 forest reservations 35 steppe reservations, 13 peat bog reservations 5 lakes, and 5 interesting rock formations The national parks of Poland differ from most others in that the peasants living in them when they were established have been left there undisturbed

WE turn from those spacious parks of Poland and wonder at the seeming lack of appreciation of such places in Great Britain A Romney Marsh bird sanctuary is a possibility—a typical marsh area, frequented by rare migrant birds in winter and inhabited by a great variety of water fowl in summer In 1928 the Royal Society for the Protection of Birds purchased here an 18 acre meadow as the beginning of a larger scheme, and now the farmer owner, himself a keen bird watcher and protector, is willing to sell additional land sufficient to complete a compact reserve of 180 acres Probably no more ideal bird sanctuary, with its open water, stretches of mud, rush and reed beds, and pasture land, is to be found in any of the marshes of south east England In many another country the State would step in to form a Government sanctuary (Canada has eighty such reserves), but we have scarcely yet reached that degree of development, and private enterprise is the only alternative The amount required for the purchase of this desirable spot is £4000, of which £500 has already been subscribed, and the Royal Society for the Protection of Birds (82 Victoria Street, London, S W 1) appeals for contributions from a bird loving public to complete the purchase

IN a short article in the *Empire Review* for May, Lord Onslow reviews the steps which have been taken in various parts of the British Empire for the preservation of the native fauna If many wild creatures are to survive they must be guarded, but it need not be supposed that the enthusiasts for protection, such as the Society for the Protection of the Fauna of the Empire, seek to preserve animals in a manner likely to cause danger to life or property They do hold, however, that experience shows that the protection of the wild fauna need not interfere with development, and that preservation is in itself an asset to any country Lord Onslow rightly emphasises that if protection is to keep in touch with development its creation of sanctuaries must not be too rigid, but must permit of temporary or permanent adjustments to the needs of the animals within and the human beings outside the reserved area How rapid are the changes which may occur is illustrated by two items in Lord Onslow's article He hopes that the British Government will proclaim as a gorilla sanctuary the British territory adjoining the Belgian Park in the Belgian Congo but such a proclamation was actually made several months ago Again he refers to the success of the introduction of deer to New Zealand, but the success has turned to nuisance, and, as a note in these columns last week indicated, there is now a widespread desire for the reduction in numbers and even the extermination of the superabundant deer

ON May 30 the Halley Lecture was delivered at Oxford by Prof A S Eddington, Plumian professor of astronomy at Cambridge, before a large and attentive audience, who thoroughly appreciated the lucidity of his exposition, and the touches of humour with which it was illuminated Before embarking on the proper subject of his discourse, namely, the rotation of the galaxy, Prof Eddington remarked that in the nineteenth century attention was principally concentrated on solar motion, which had to be allowed for in estimating the value and amount of stellar motions generally The aspects which are now engaging attention are star streaming, correlation between velocity and physical characteristics, between velocity and approach towards or recession from our system, and finally the rotation of the galaxy itself The galaxy is a flattened, almost disc like system, which presents a rough resemblance to the system of Saturn's rings The solidity of the latter system was shown by Clerk Maxwell to be impossible dynamically That the rings consist of comparatively small particles rotating about a centre, the outer particles moving at a slower rate than the inner, has been confirmed by spectroscopic observation

CONTINUING, Prof Eddington said that as the stars have individual as well as rotational motion, it is necessary in investigating the motion of a system such as the galaxy, to subject a large number of stars

to observation. An attempt has been made, by using the asteroids on the analogy of Saturn's rings, to find the centre of the galactic system; an obstacle to this endeavour is the fact that the proper motions of stars in the southern hemisphere are not sufficiently well known,—"it is like flying with one wing." Prof. Eddington concluded by touching upon the many dynamical problems involved in the modern conception of the stellar universe, and the unifying influence of the hypothesis of a 'cosmic cloud' pervading space, with its attribute of viscosity. A hearty vote of thanks was accorded to Prof. Eddington on the motion of Prof. E. A. Milne, seconded by Prof. H. H. Turner, the latter of whom took occasion to refer to the need pointed out by Prof. Eddington for additional centres of observation in the southern hemisphere, in connexion with the question of the future destiny of the Radcliffe bequest.

THE National Broadcasting Company of the United States charges no licence fee for listening in to its programmes. According to an interview with Mr. James, the promotion manager of the Company, which appeared in the *Daily News* for May 28, the necessary revenue is obtained by allowing commercial companies to 'sponsor' programmes. The big business houses buy broadcasting time at the rate of £2000 an hour. Of this time not more than five minutes must be taken in telling listeners about the firm and its activities. No charge is made to universities if they desire to send out educational broadcasts, but apparently they do not take advantage of this offer. Talks are strictly limited to fifteen minutes and the silent periods must not exceed half a minute. When listeners dislike a particular type of programme they write to the company making complaints. The N.B.C. serves a great chain of seventy-six broadcasting stations stretching from the Atlantic Ocean to the Pacific. Advertisers can buy up the broadcasting time of all the stations in a particular area of the United States. It is interesting to notice that gramophone records are banned. Mr. James states that the total business turnover is about five million pounds a year. The advertising companies take up about 60 per cent of the total broadcasting time. They find that it pays to give excellent programmes. A cereal company, for example, gives children's programmes at breakfast time, and some of the largest companies give excellent classical programmes. No charge is made for broadcasting church services. In Great Britain, owing to the terms of the charter for the B.B.C., there is no advertising by radio.

THE financial difficulties by which the Australian Government is beset are acutely affecting the position of the Council for Scientific and Industrial Research. It appears inevitable that the erection of the proposed forest products laboratory in Sydney must be postponed and also that of a joint administrative block (including museum, lecture hall, and offices) for the entomology and plant industry divisions at Canberra. The contract for the main plant industry laboratories was, however, let before the present situation developed and the work will now go to completion. Plans for the McMaster Laboratory for animal health in the grounds of the University of Sydney have been adopted and building will shortly begin. The Darling Laboratory for soil science, placed in juxtaposition to the Melrose Laboratory at the Waite Institute, Adelaide, will soon be ready for occupation. While, therefore, it is apparent that the next two years will be exceedingly difficult for the Council, with little or no prospect of any extension of activity, there is reason to hope that the main lines of work initiated during the past four years will not suffer a serious set-back. A very encouraging fact is a decision just announced by the directors of the Commonwealth Bank to present a sum of £13,000 from the Rural Credits Fund to the Council to enable it to carry out certain projects which otherwise would have been abandoned, or at least seriously curtailed. £10,000 will be used in the erection of a plant house at Canberra, and £3000 will provide for insectaries for the study of blowfly and buffalo fly (*Lyperosia exigua*) problems.

IN his Friday evening discourse, delivered at the Royal Institution on May 30, Sir Harold Carpenter discussed the metal crystal. When prepared by one of the usual methods, metals and alloys consist of an aggregate of small allotriomorphic crystals and contain from about one hundred thousand to several millions of crystals per cubic inch. Their properties accordingly are the properties of aggregates and are therefore composite. In all metals, however, the individual crystal is the unit of which the aggregate is built. It is therefore the simplest form of metal. From a scientific point of view, the study of individual metal crystals should precede that of aggregates. This enables any particular property of the metal crystal itself to be studied, the only variable being its orientation. It is the realisation of this fact which has given rise in recent years to definite attempts to prepare single metal crystals. Success has been achieved in three different ways: (1) By the production of the crystal from the vapour phase; (2) by its production from the liquid phase; (3) by conversion of the solid metal in the ordinary polycrystalline aggregate into a single crystal. Each of these is an example of *controlled* crystallisation. The mechanical and physical properties of the single metal crystal are, in the majority of cases, directional. This fact is more strikingly illustrated in the mechanical tests, because the single crystal test pieces undergo distortion and assume new and striking forms. In both categories, however, the properties of the single crystal differ from those of the crystal aggregate, depending upon its particular orientation. Single crystal alloys have been investigated to a less extent but, in so far as evidence is available, it indicates that the same holds for them. Future research will involve the controlled production of single crystals in particular orientations. Such knowledge will form the basis of the scientific manufacture of metals and alloys possessing properties which can be specified with accuracy and certainty.

WE are glad to see in the report of the Board of the Institute of Physics, adopted at the annual meeting of the Institute on May 27, that the *Journal of*

Scientific Instruments continues to make progress The *Journal* publishes many valuable articles and is of decided service in the laboratory and the instrument shop There is a special section devoted to laboratory and workshop notes, and an appeal is made for increased contributions to this section from workers in laboratories, workshops, and drawing offices, etc The *Journal* is distributed to fellows at the cost of the Institute and to associates and registered students at the reduced price of 10*s* 6*d* per annum

DR W H ECCLES, in the course of his presidential address, pointed out that the Institute of Physics was incorporated in 1920 in order to form into a professional body all physicists interested in industrial applications Trained physicists had provided so many ingenious and useful weapons of attack and defence during the War that there was every anticipation of their future importance in British industry during peace Until nearly the end of the War physicists who were occasionally called upon to enter the service of the State were officially classed as 'chemists', as the word 'physicist' had not appeared in the official vocabulary, and those who had entered industry did so in the guise of 'engineers' The need for a professional Institute of Physics was evident The stability which the Institute has attained after a life of ten years shows that the founders were justified in their belief that the time had come to secure for physicists a position comparable with that of professional workers in other departments of applied science and that an organisation was required to represent them Dr Eccles was re elected president and other officers appointed were as follows, in addition to a number of members of the Board not subject to election *Vice President*, Dr R S Clay, *Hon Treasurer*, Major C E S Phillips, *Hon Secretary*, Prof A O Rankine, *Non Official Members of the Board*, Prof J A Crowther and Sir Richard Gregory

THE appointment announced last week of Prof H R Robinson to the chair of physics at East London College, will strengthen the distinguished body of physicists already associated with the University of London, and East London College may be congratulated on obtaining so distinguished a successor to Prof C H Lees, who is retiring shortly Prof Robinson was born on Nov 26, 1889 and studied at the University of Manchester, where he obtained the D Sc degree in 1917, and at the University of Cambridge, where he obtained the Ph D degree in 1924 He has been lecturer (1912–14) and assistant director (1919–21) of the Physical Laboratories in the University of Manchester, Moseley Research Student of the Royal Society (1921–23), reader and Carnegie Teaching Fellow in the University of Edinburgh (1923–26) and since October 1926 professor of physics at University College, Cardiff He was elected a fellow of the Royal Society in 1929, and has published numerous papers on radio activity, X rays and atomic structure, and similar topics in the *Proceedings* of the Royal Society and the *Philosophical Magazine*

IN recent years various heavy metals either as salts or in colloidal solution have been recommended for therapeutic purposes especially in the treatment of tuberculosis and of cancer The rationale of this treatment is the assumption that the pathological cells or tissues have a special affinity for a certain heavy metal, which thus exercises a direct toxic action on the abnormal cells in which it accumulates Thus the lead treatment for cancer introduced by Blair Bell was based on the assumption that cancer cells have a special affinity for lead It is therefore of importance to have accurate data concerning the distribution of various heavy metals after injection into an animal This problem is dealt with in a recent paper by G Hevesy and O H Wagner in which mice bearing a transplanted tumour received injections of small amounts of thorium, of lead, and of bismuth (*Arch f exp Pathologica und Pharmakologie*, vol 149, p 336, 1930)

BY the ingenious device of injecting a heavy metal together with its radioactive isotope and making electroscopic measurements with the ash of the various tissues, Prof Hevesy and Mr Wagner have overcome the difficulty of determining accurately the extremely minute quantities of the various metals which may be present in the tissues The method is of an astonishing delicacy since the amounts of tissue analysed were almost always less than 1 gm and the amount of metal found is given in units of 1/1000 of a milligram to the fourth decimal point The analyses show that neither thorium nor lead accumulates in the tumour cells If, therefore, lead has any therapeutic effect in cancer it must be an indirect one Bismuth, on the other hand, shows a striking selective accumulation in tumour cells These may contain from five to fifty times as much bismuth as the surrounding normal tissues This confirms the observations of H Kahn (*Klin Wchnschr*, vol 6, p 2335, 1927), who has used bismuth preparations in the treatment of cancer with, as he claims, encouraging results

LESS than four years ago, the Japanese Earthquake Investigation Committee, after more than thirty years of useful work, was transformed into the Earthquake Research Institute, the sole object of which is the promotion of scientific inquiries (NATURE, vol 119, p 576) The first volume of the *Bulletin* of the new Institute was published in 1926, and in each succeeding year two volumes have appeared, the last part of the seventh volume having lately reached us Some idea of the value of the new journal may be gathered from the fact that the seven volumes contain 106 papers, 1704 pages, and 198 plates In the first volume, all the papers were written in Japanese, but were provided with summaries in English or French Since then, fortunately for European readers, the number of papers in their languages has greatly increased, until in 1929 two out of every three papers were printed in English, French, or German A welcome and very remarkable feature is the extraordinary increase in the number of authors Up to 1923, the year of the great earthquake, 96 per cent of the papers in the *Bulletin* of the Earthquake Investigation Committee appeared under the name of Prof Omori In the new *Bulletin* there are papers

by 41 authors, twelve of whom are frequent contributors. While many writers continue to deal with the Kwanto earthquake of 1923 and the Tango earthquake of 1927, almost the whole field of seismology is covered. Among the more important contributions may be mentioned the mathematical investigations on wave motion by K. Sezawa, the time curves of various earthquakes by T. Matuzawa, the studies on the after-shocks of the Tango earthquake by N. Nasu, and the observations on the tilting of the ground before earthquakes by M. Ishimoto.

THE Second International Conference of Benzole Producers met in London on May 30 and 31. Delegates were present from Belgium, Czechoslovakia, France, Germany, Great Britain, Holland, Italy, Poland, and Spain, and they were received by the president, Sir David Milne Watson, president of the National Benzole Association. The Conference was opened by a speech of welcome by M. H. Laurain, president of the International Conference of Benzole Producers. Sir David Milne Watson in his address outlined the remarkable progress which has been made in the production of benzole during recent years, principally in Great Britain and Germany. Five papers were read at the Conference dealing with motor fuels for high compression engines, resin formation in motor spirits, estimation of gum in motor benzoles, the European benzole market position, and sales organisation, respectively. These were followed by a kinematograph film showing what has been done to exploit British produced benzole in Great Britain. The Conference concluded with a visit to the distribution depots, research stations, and various transport workshops of the National Benzole Company, Limited.

MR. C. C. PATERSON, director of the Research Laboratories of the General Electric Company, Ltd., Wembley, has been nominated for election as president of the Institution of Electrical Engineers in succession to Sir Thomas Purves, whose term of office ends on Sept. 30 next.

AT a recent session of the Council of the League of Nations, the Health Committee of the League was reconstituted for a further three years. Sir George Buchanan, senior medical officer, Ministry of Health, has been reappointed a member, and Dame Janet M. Campbell, also of the Ministry of Health, is a new member.

WE are informed that the Secretary of State for Scotland has appointed Sir William E. Whyte to be chairman of the Scottish Advisory Committee on Rivers Pollution Prevention in succession to the late Sir John R. Findlay, Bart., of Aberlour. Sir William has been a member of the Advisory Committee since its inception. The Secretary of State has also appointed Mr. David N. MacKay, of Messrs. MacKay, Paterson, and Chalk, solicitors, Glasgow, to fill the vacancy on the Committee caused by the death of Sir John Findlay.

THE Council of the Institution of Civil Engineers has recently made the following awards in respect of papers read and discussed at the ordinary meetings during the session 1929–30: Telford Gold Medals to Messrs. David Anderson (London) and B. B. Haskew (Weston-super-Mare); a Watt Gold Medal to Mr. A. E. L. Chorlton (London); Telford Premiums to Mr. W. T. Everall (Lahore), Prof. E. G. Coker (London), Messrs. G. L. Groves (Croydon), R. C. Bristow (Cochin), E. T. Ward (Sulina, Roumania), Gerald Lacey (Bombay), R. W. S. Thompson (Sheffield), and R. F. Hindmarsh (Newcastle-on-Tyne).

THE second Daniel Guggenheim gold medal for notable achievements in aeronautics has been awarded to Dr. Ludwig Prandtl, of the University of Göttingen, "for pioneer and creative work in the theory of aerodynamics". The first award of the Guggenheim Medal was made to Orville Wright a year ago, and the medal was presented to him in Washington on April 8 in connexion with the celebration of the fiftieth anniversary of the American Society of Mechanical Engineers. The medal is awarded by a corporation consisting of representatives of the American Society of Mechanical Engineers and the Society of Automotive Engineers, with five representatives of foreign engineering bodies, one each in England, France, Germany, Italy, and Japan.

A CLEARANCE list (No. 177) of books on entomology, geology, mineralogy, and general zoology, including mammalia, invertebrates, and ornithology, has just been issued by Messrs. Dulau and Co., Ltd., 32 Old Bond Street, W.1. Nearly 700 items are listed.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Two veterinary surgeons under the South West Africa Administration—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (June 11). A teacher of mining and allied subjects at the Doncaster Technical College—The Secretary, Education Offices, Doncaster (June 14). An agricultural economist in the Department of Agriculture, Kenya—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (June 16). A junior officer in the wood technology section of the Forest Products Research Laboratory, Princes Risborough—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (June 16). A lecturer in the Department of Mechanical Engineering of the Borough Polytechnic—The Principal, Borough Polytechnic, S.E.1 (June 16). An assistant organiser for dairy husbandry under the Wilts County Council—The Clerk of the County Council, County Offices, Trowbridge (June 18). A physicist in the Forest Products Research Laboratory, Princes Risborough—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (June 19). A part-time lecturer in philosophy and logic at Birkbeck College—The Secretary, Birkbeck College, Fetter Lane, E.C.4 (June 20). A full-time teacher of science—principally chemistry and botany—at the Shrewsbury Technical College—The Clerk to the Committee of Management of the College, Guildhall, Shrewsbury (June 21). An advisory officer in glass-house work and market gardening under the Kent

Education Committee—The Agricultural Organiser, Springfield, Maidstone (June 21) An assistant for bulb research at the Agricultural Institute and Experimental Station, Kirton, Lincs —The Principal, Agricultural Institute, Kirton, near Boston, Lincs (June 21) An instructor in building for the Government Technical Schools, Uganda—C A (T), The Secretary, Board of Education, Whitehall, S W 1, Scottish candidates, (C A), The Secretary, Scottish Education Department, Whitehall, S W 1 (June 23) A pathologist to the Cancer Hospital—The Secretary, Cancer Hospital, Fulham Road, S W 3 (June 23) An assistant in the botany and pharmacy department of the Dundee Technical College—The Secretary, Technical College, Bell Street, Dundee (June 23) An engineering workshop instructor at the Technical College, Port Elizabeth—G H Penney and Co, 23 Lime Street, E C 3 (June 24) A full time secretary of the Universities Bureau of the British Empire—The Secretary, Universities Bureau, 50 Russell Square, W C 1 (June 25) Two senior timber assistants in the Forest Utilisation Circle, Burma—The Secretary to the High Commissioner for India, General Department, India House, Aldwych, W C 2 (June 30) Two assistants on the higher technical staff of the Science Museum, one in the industrial engineering and manufactures department and one in the mechanical engineering, land transport and construction department—The Director and Secretary, Science Museum, South Kensington, S W 7 (July 4) Probationary assistant engineers in the engineering department of the Post Office—The Secretary, Civil Service Commission, Burlington Gardens, W 1 (July 10) A lecturer in charge of the Department of Zoology of the Natal University College—The Registrar, Natal University College, Pietermaritzburg, South Africa (Sept 24) A lecturer in mathematics in the University of Reading—The Registrar, University, Reading A teacher of electrical engineering at the Watford Technical School—The Principal, Technical School, Watford A secretary of the Institution of Engineers and Shipbuilders in Scotland—The Institution of Engineers and Shipbuilders in Scotland 39 Elmbank Crescent, Glasgow C 2 A chief engineer for the Manchester Steam Users' Association—The President of the Manchester Steam Users' Association, 20 Quay Street, Manchester A chemical laboratory assistant in the Experimental Department of the Fine Cotton Spinners' and Doublers' Association, Ltd —The Chief of the Department, Rock Bank, Bollington, nr Macclesfield A woman lecturer in botany and chemistry at the Studley Agricultural College—The Principal, Studley Agricultural College, Warwickshire

Our Astronomical Column

Comets —Comet 1930*d* (Schwassmann Wachmann), discovered at Bergedorf on May 2, is interesting for the near approach that it makes to the earth early this month It is evidently a periodic comet and Prof Yamamoto asks that a lookout should be kept for possible meteors from it He gives June 9 for the middle of the shower, and χ Herculis as the radiant point No accurate orbit is yet to hand, but the following by Dr A C D Crommelin, from observations on May 2, 12, 22, suffices to give some idea of it

T	1930 June 14 050 U T	
ω	192° 4′ 7″	1930 0
Ω	76 59 19	
i	17 36 32	
ϕ	43 47 17	
log a	0 51661	
log q	0 00517	
Period	5 9555 y	

The elements do not appear to resemble those of any comet previously observed

Another comet, 1930 *e*, was discovered by Mr Forbes at Cape Town on the morning of May 31, it was of the ninth magnitude, its position was R A $23^h 45^m$, South Decl 33° 38′, daily motion 4′ west, 24′ north It is too far south to be observed in England It is Mr Forbes' third discovery, in November 1928 he found a comet that had already been observed in 1818 and 1873, and in 1929 he found a periodic comet not previously observed

The Large Fireball of May 16 —A considerable number of observations have been received of this object, but they are nearly all by casual spectators of such phenomena and therefore imperfect and in some cases erroneous There is no doubt, however, as to the splendour of the object, though it appeared in the evening twilight when very few stars were perceptible Descriptions have come from Lancashire, Yorkshire, and other counties, and many interesting notes have been sent from South Wales The fireball had a long flight from east to west over the central region of England onwards to the Irish Sea, and it apparently vanished when it reached the Irish coast Pursuing a course of more than 200 miles, its height declined from 65 miles to 43 miles at a velocity of about 25 miles per second Several observers thought it was comparable in size with the moon, but this would make the object about a mile in diameter, whereas if the effects of glare and flame are eliminated the actual size would be probably about 1 or 2 feet The radiant point was in Scorpio or Ophiuchus, and it is quite remarkable that this region supplies many fireballs at various periods of the year and particularly in the spring months of May and June The great meteor of Dec 3, 1929, apparently emanated from the same region of sky, but the data were not absolutely trustworthy

The Oldest Known Star Catalogue —Most text books state that Hipparchus was the first to draw up a catalogue of stars, but it appears that in this, as in many other respects, the East anticipated the West The *Memoirs of the College of Science of Kyoto University*, vol 13, No 1, contain a paper by Joe Meta on the Chinese catalogue of Shih Shên, which he dates at about 360 B C, or two centuries before Hipparchus It is in 120 volumes, which contain a large admixture of astrology, this appears to have been one of the main motives of early celestial observations, but it had the good effect of causing careful records of phenomena to be preserved The zodiac is divided into the 28 lunar mansions, 62 northern asterisms, and 38 southern ones The identification of the stars gave much trouble, which was increased by numerous copyists' errors in the MSS The paper describes the method of dating the catalogue, which was mainly done from the recorded declinations of the stars, and closes with the list of asterisms, which gives the Chinese names and their meanings, also the extent of each The measures are in Chinese degrees, of which there are 365¼ to the circumference

Research Items.

Atmospheric Pollution.—The Report recently published for the year ending March 1928 of the Atmospheric Pollution Research Committee of the Department of Scientific and Industrial Research is a quarto pamphlet of 68 pages, 40 of which are occupied by tables. The majority of the records are obtained by means of a glazed earthenware or glass funnel on the sides of which solid particles from the air deposit themselves and are washed by rain into a bottle placed below. Each month the contents of the bottle are analysed and the tons of deposit per square mile calculated. Rochdale has 13 of these gauges, London 11, and Glasgow 9. At Rochdale one gauge is placed at the centre of the town and the others within a mile of the centre. The average deposit per month is 33 tons per square mile, of which 15 tons are soluble. London has one station at which the deposit is about as heavy as that at the worst of the Rochdale stations, but stations at Kew and Victoria Park reduce its average to about 70 per cent of the Rochdale average. Glasgow has no station at which the deposit reaches 70 per cent of the worst London and Rochdale stations and its average is about 72 per cent of the Rochdale average. Rothamsted, Southport, and Kingston upon Thames get about a third of the average Rochdale deposit.

Chinese Mammals.—Since no attempt has yet been made to compile a list of all the mammals found in China, N. Gist Gee has made a praiseworthy and useful effort to gather together, without detailed specific revision, the records which so far have been made (*Peking Soc. Nat. Hist. Bull.*, vol. 4, p. 49, 1930). In the circumstances, the list cannot be regarded as perfect, but its value is obvious as a groundwork upon which future investigations of the mammalian fauna can be based. The list, which includes sub-species, gives one or two references to literature in each case and states the provenance. It covers 42 pages and comprises round about 700 species and sub-species.

External Parasites of British Birds.—A short but useful paper by R. S. Bagnall and W. Hall, written in 1912 and only now published (apparently without further editing) gives a list of mallophaga identified from some British birds (*Vasculum*, May 1930). Fifteen species of birds are dealt with here and the need for the examination of their lice is apparent in the nineteen species which are recorded for the first time as British, while species from the fulmar petrel and the little auk are new to the fauna of Europe. It is a remarkable and significant fact that the lice from these two British birds belong to species which have hitherto been found only on related species on the Californian coast.

Researches on Earthworms.—*Pheretima* is a genus of earthworms much used for experimental study in Japan. In the *Science Reports of the Tôhoku Imperial University* (Fourth Series (Biology) Sendai, Japan, vol. 4, No. 4, December 1929) there are two papers on this subject, the first by Hideomi Tuge, "On the Number of Ganglion Cells in the Suprapharyngeal Ganglion and in the XXX Ventral Ganglion of the earthworm *Pheretima megascolidioides* (Goto and Hatai)", the second by Teruhei Hino, on "Carbon Dioxide Production in relation to the Growth of Body of earthworm *Pheretima communissima* Goto et Hatai." *Pheretima megascolidioides* measures 1½ feet when fully extended and is well adapted for experimental study. It was found that the number of ganglion cells in segment XXX was considerably larger than in the corresponding segment of smaller species previously used. In the suprapharyngeal ganglion one pair of nerves is associated with more than twice as many cells than the pair of nerves in the ventral ganglion. Mr. Teruhei Hino, who reared his worms from eggs, states that the gaseous metabolism in *Pheretima communissima* bears a direct relation to the body surface, and the carbon dioxide production per sq. cm. per hour is constant during the greater part of the growing period. When the sexual organs begin to develop the rate rapidly increases, to fall again after the breeding period.

Myriopoda of the Swiss National Park.—Dr. W. Bigler in an elaborate memoir has described the Myriopoda Diplopoda in the region of the Swiss National Park ("Die Diplopodenfauna des Schweizerischen Nationalparks". Ergebnisse der wissenschaftlichen Untersuchung des schweizer National parks, herausgegeben von der Kommissionen der S. N. G. zur wissenschaftliche Erforschung des National parkes, December 1928 (1929)). This is specially a study in distribution and in the region which embraces various habitats including much high land, we find a large number of Myriopods belonging to the groups recorded. Besides the actual National Park reservations, neighbouring localities were also studied for comparison. Each genus and species is carefully described with details which affect their systematic position, especially the auxiliary copulatory apparatus of the male, which is of considerable importance in classification. Many species are found so far up as 2800 metres, those from the greatest heights belonging to the Julidæ and Ascospermophora. Between 1300 metres and 2800 metres the maximum occurs at about 2100 metres, the woodland limit being at 2200 metres. The largest numbers belong to the Glomeridæ, which range from 1450 metres to 2700 metres, and the Julidæ (having the widest range), from 1300 metres to 2800 metres. The work is of much interest and greatly extends our knowledge of distribution and habitat of the Diplopoda.

Australian Fisheries.—A map of the fisheries of Australia, prepared by the Development and Migration Commission for the information of the members of the Australian Fisheries Conference, has recently been issued by the Australian Government. Several attempts have been made to discover suitable trawling grounds around the coast especially in the south, and the positions of these explorations have been indicated by coloured signs. The most important work of the kind was that done by the Federal Investigation Ship *Endeavour* between 1909 and 1913, but it was not continued after the unfortunate loss of that ship. A series of notes is printed on the map containing information on the present position of the fishing industry in Australia, and these notes, used in conjunction with the map itself, give a clear indication of what has already been done and of the developments which are immediately called for. The map, which in addition to fishery information gives isotherms showing air temperatures over the land, as well as sea temperatures, has been well reproduced by the Hydrographic Branch of the Navy Office at Melbourne.

Standardisation of a Plate Method of Counting Soil Actinomyces.—The study of the Actinomyces group of micro-organisms is as yet in its infancy, but enough is already known to indicate that these fungi play a very significant rôle in Nature—either as injurious

parasites to animals and plants, or as beneficial saprophytes which help to break down complex organic matter to humus in the soil It is in the latter rôle that a special interest now attaches to them One of the greatest difficulties in estimating the activities of the Actinomyces in the soil has been that of counting their numbers, since no two of the culture media in general use yield results which are at all comparable Messrs M Ganesha Rao and V Subrahmanyan (*Jour Ind Inst Sci*, vol 12A, part 18, pp 253 273) have done mycology a great service in comparing the variable counts obtained by the use of a considerable number of standard media, and in evolving a new synthetic media which gives maximum and consistent results This is the type of problem which by reason of its laborious and unimaginative character is usually avoided by research workers Its results, though simple, are often of more fundamental service to science than those of more spectacular problems, and we congratulate the authors on having carried the present one to a successful conclusion

Cotton Yield and the Flowering Curve—Mr N W Barritt has an interesting discussion of the possible correlation between the production of flowers by the cotton plant and its subsequent production of cotton in the *Empire Cotton Growing Review* vol 7, April 1930 He points out that Egyptian workers on cotton have a general impression that the ideal plant should have a steep and narrow flowering curve, so as to ensure an early crop capable of being picked almost in one operation 'This belief appears to be based chiefly on the fear of the pink boll worm, notwithstanding the fact that Williams in 1926 showed conclusively that the increase in the boll worm always kept pace with the growth of the crop" Barritt examines some yields given by C H Brown for two new strains of cotton grown side by side in four different localities in Upper Egypt Both strains give identical flowering curves which are very different in the different localities, and in both strains the broad flat flowering curve is definitely superior to the short steep curve Barritt suggests very reasonably that this is because, with the steep flowering curve, most flowers open on the same day, and if these bolls afterwards ripen, such bolls are competing more intensely for the available carbohydrates, with, as a result, some starvation of the developing lint

Cultivation of the Castor Oil Plant—Castor oil with its capacity for remaining liquid at low temperatures whilst it retains its high viscosity at high temperatures, has proved of great value as a lubricant in internal combustion engines, and especially in aeroplane engines It is also used in the dye industry, in the manufacture of Turkey red, whilst the pure cold-drawn oil, which is free from the poisonous ricin contained in the seeds, is of course employed in medicine as a purgative Its usefulness as a lubricant, particularly, points to an extension of its employment, and though the plant is scheduled in parts of New South Wales and Queensland as a 'noxious weed', there is probably good reason, in many tropical and sub tropical regions, to consider carefully the possibilities of *Ricinus communis* as a crop The plant is singularly variable in cultivation, yielding profusely in some places, whilst in apparently similar situations nearby, it may be very disappointing The suitability of the plant for unused pieces of land, on the borders of cultivation, in refuse heaps and other waste spots, together with the ease with which the seed can be collected, make it almost an ideal crop for the small cultivator, or as a catch crop in permanent cultivation, provided that local conditions provide a good market for comparatively small quantities of seed The habit of growth and method of cultivation of the plant, together with methods of oil extraction, etc, are dealt with fully in an article in the *Bulletin of the Imperial Institute*, vol 28, No 1, 1930 At present, India is the chief source of the world's commercial supply of castor oil, but instead of the primitive method of expressing the oil used in India, the seeds are tending more and more to be exported, especially to England and America Brazil is also exporting both castor seed and oil

Japanese Tectonics—In the *Jap Jour Geol and Geog Trans*, **7**, No 1, 1929, S Yehara publishes the results of nine years' study of the geology and tectonics of Shikoku together with a beautifully printed geological map of the island and a map of the Japanese Islands illustrating tectonic movements during the Cainozoic The dominant fracture belt is the 'Median tectonic line' which came into existence in south west Japan about the close of the Triassic All the pre Tertiary rocks have been affected by movements exorted from the north (Lower Triassic and post Jurassic) The north east–south west trend lines of the Cainozoic are referred to the 'peri Setouchi' movement The trend lines of Kyushu and the Riu kiu festoon are similarly referred to the 'peri Iunghai' movement The two arcs cross in the extreme south west of Japan and in the straits between Kyushu and Korea To the west and north the trend lines are very different In addition to the volcanic line of the Bonin Islands, there are the mountain ranges of Abukuma and Kitakami (in the north of the main island) and of Hidaka (in Hokkaido) All these extend north north west to south south east The horizontal pressure responsible for the movements is regarded as having come from the east, that is, from the Pacific, and is referred to the 'peri Tuscarora' movement

Investigation of Electrolytic Dissociation by the Raman Effect—A paper by Dr I R Rao in the May number of the *Proceedings of the Royal Society* gives further details of his work on the Raman spectra of nitric acid A modified form of Prof R W Wood's apparatus was employed, and both the origin of the ten sets of Raman lines established, and the relative intensities of a number of the satellites measured by means of a microphotometer, to obtain quantitative information about the numbers of NO_3 ions and undissociated HNO_3 molecules responsible for the scattering The change in the degree of dissociation with progressive dilution could then be followed on the assumption that the intensity of the scattered light at 4567 A was proportional to the number of free ions present Extension of this work should permit of a decision between the alternative theories of complete dissociation at all dilutions and progressive dissociation with increasing dilution, at least in the case of this particular strong electrolyte

Liberation of Electrons by Positive Ions—A form of apparatus for investigating the liberation of electrons from metal surfaces by positive ions is described by M L E Oliphant in the May number of the *Proceedings of the Royal Society* The problem is complicated by the fact that the most convenient source of ions, an electric arc in gas at rather low pressure, must be in direct connexion with the chamber in which the ions are made use of, and the latter must be kept at very low pressure, so that differential pumping must be employed In Dr

Oliphant's work the ions were drawn from a helium arc through a positive ion sheath on to an auxiliary electrode, which collected most of them, but allowed a few to pass through a small hole to a second chamber. There they were sorted out from metastable atoms, given the desired speed, and allowed to impinge on a target. The electrons set free from the latter were analysed by a retarding field, or magnetically, the system of electrodes used in the second method being particularly ingenious and delicately mounted. Dr. Oliphant has obtained a considerable volume of valuable data, and has been able to show, in a second communication in conjunction with Mr. P. B. Moon, that all essential features of his results agree well with current ideas of the electrical structure of metallic surfaces.

Electrometric Hydrogen Ion Measurements.—Measurements of the hydrogen ion concentration of solutions are being recognised as of increasing importance not only in many fields of research but also in nearly every industry. To those who have not yet installed an electrometric apparatus for this purpose the Cambridge Instrument Company's new list (No. 108) of instruments will be welcome as a guide to the selection of a suitable equipment. The general designs are along well tried lines and the following comments refer only to the more novel features. The potentiometer recommended for the highest accuracy has a selector switch so that measurements on three different solutions can be carried out in rapid succession. For more general and industrial work there are two self-contained portable potentiometers embodying Unipivot galvanometers with standardisation from either the galvanometer itself or, in Mr. S. W. Cole's pattern, from a Weston standard cell built into the instrument. The second pattern may be used with either a dry battery or an accumulator and has additional scales giving temperature corrections and direct readings of pH values. Dr. P. T. Kerridge's glass electrode outfit with a Lindemann electrometer has advantages where only small amounts of solution are available or where the hydrogen and quinhydrone electrodes are disturbed by oxidation or reduction. A recording potentiometer in conjunction with double quinhydrone electrodes is used to record pH values automatically and to give audible warnings when critical values are reached. The list includes a brief discussion and bibliography of typical industrial and research applications.

Formation of Iron Pentacarbonyl.—By the examination of the contents of a steel cylinder containing compressed coal gas which has been standing since 1899, Friend and Vallance found that considerable amounts of iron pentacarbonyl $Fe(CO)_5$ had been produced. The pressure of the gas was probably between 50 atm. and 80 atm. The observations are recorded in the April number of the *Journal of the Chemical Society*; other recent researches noticed in NATURE also show that small quantities of iron carbonyl may be formed from carbon monoxide under pressure in steel cylinders during a period of a few weeks.

Chlorides of Sulphur.—Attention has been directed in previous notes to the investigations of Lowry and his collaborators on the chlorides of sulphur, the compounds S_2Cl_2, SCl_2, SCl_4, and S_2Cl_4 having been described. The researches have been extended by Lowry and Jessop, in the April number of the *Journal of the Chemical Society*, in which measurements of the dielectric constants of sulphur chloride mixtures over a range of composition from monochloride to chlorine and from room temperature down to the freezing points are described. The isothermals for the liquids confirm the existence of sulphur dichloride but do not show any inflection corresponding with the tetrachloride, even at $-50°$. The dielectric constants of the solids, however, show a pronounced maximum at the composition of the tetrachloride, indicating, in agreement with previous work, that this compound exists in the solid state.

Structure of Strychnine and Brucine.—In the Bakerian Lecture delivered before the Royal Society on May 29, Prof. Robert Robinson, Waynflete professor of chemistry in the University of Oxford, discussed the experimental evidence which is available for the development of structural formulæ for the highly complex molecules of the alkaloids strychnine and its dimethoxy derivative brucine. From a study of the products of electrolytic and catalytic reduction, of nitration and oxidation, and so on, it has been possible to draw numerous conclusions which go far to establish the orientation of the various groupings in the two molecules. Thus strychnine, which possesses the molecular formula $C_{21}H_{22}O_2N_2$, appears to be a polycyclic compound, which contains (*a*) an ethylene linkage, (*b*) an etheric oxygen atom, which is almost certainly a member of a heterocyclic ring, (*c*) a tertiary basic nitrogen atom, (*d*) a cyclic amide group $>N \cdot CO \cdot CH_2$—, in which the nitrogen atom forms part of another heterocyclic ring, and (*e*) a benzenoid ring, to which this second nitrogen atom is directly attached. It is this aromatic nucleus which carries the two methoxyl groups in the molecule of brucine. A structural formula expressing the ascertained facts with a high degree of probability is given in Prof. Robinson's paper.

Inductive Interference in Telephone Circuits.—The troubles that arise owing to the inductive interference of power transmission lines with telephone circuits were discussed by Colonel Sir T. F. Purves, the engineer to the Post Office, in an interesting speech at Sheffield on Feb. 19 to the local section of the Institution of Electrical Engineers. He mentioned that the Comité Consultatif International des Communications Téléphoniques à Grande Distance (C.C.I.) has for some time been studying how to protect communication circuits both from inductive interference and from electrolytic action due to neighbouring power lines. The C.C.I. has issued a set of guiding rules to minimise inductive interference and to fix limits for the maximum disturbance permissible. There were, however, several outstanding problems which were being investigated by another international body, the Commission Mixte Internationale (C.M.I.). The most important problem at the present time is the dangerous inductive effects which occur in communication circuits when a fault arises on a high tension transmission line. 'Acoustic shock' is generally caused when a voltage sufficiently high to operate the lightning protectors (about 350 volts) is induced in the two wires of the telephone circuit. The lightning protectors which are on each side of the circuit do not act simultaneously. The charge consequently passes through the operator's set and the diaphragm of the telephone receiver is brought into violent contact with the pole pieces. The ear of the listener can be permanently damaged in this way. Even if it is not, frequent disturbance of this kind affects the nerves of listeners. In the case of operators, the loss of morale is often so serious that continued work becomes impossible. Sir Thomas Purves stated that in Germany and America the trouble due to this cause is very serious. The British Post Office has adopted 300 volts as the maximum permissible induced longitudinal voltage possible in a circuit, but it is very difficult to predict by computation

The Physical Society's Discussion on Magnetism

THE discussion on magnetism organised by the Physical Society and held on May 23, at the Imperial College of Science and Technology, admirably illustrates the thesis that with advancing knowledge our concepts of a particular region of Nature, even though they may serve to correlate a wider range of phenomena, become less clear cut and more diffuse and difficult to follow

When Sir Alfred Ewing formulated his magnetic models, our knowledge (in great measure due to his own happily conceived experiments) was confined mainly to the properties of the ferro magnetic elements, and that knowledge could be subsumed under certain relatively simple concepts Sir Alfred, in his opening address, reminded us that his own model, though not to be regarded as anything more than a piece of symbolism, could still assist in clearing our views concerning certain ferro magnetic properties He illustrated this position by instancing a criticism of the model made by Swinburne, who pointed out that its behaviour indicated the unlikely condition of a zero hysteresis loss in a revolving field strong enough to produce saturation Though the fact has almost escaped notice, experiments by Baily on the hysteresis loss in a revolving field have shown that the loss increases with increasing field strength to a maximum and then does fall almost to zero when the field is strong enough to produce saturation

About the beginning of this century, Curie's investigations, developing the fundamental observations of Faraday had resulted in the well known generalisations that the mass susceptibility of a diamagnetic was independent of the temperature, and of a paramagnetic varied inversely as the absolute temperature The concept of the magneton was shadowed forth so far back as the eighteen seventies by Weber, in a model identical with that of simple electron theory, save that the rôles of the electricities are reversed Weiss gave the name to a fundamental unit of magnetic moment obtained from a study of the mass susceptibility per gram atom, and a knowledge of Avogadro's number, the number of atoms in the gram atom Such atomic magnetic moments were always found to be integral multiples of a fundamental quantity, the Weiss magneton, $18\ 54 \times 10^{-22}$

It is easy to calculate by the classical laws, the magnetic moment of the magnet competent to produce the field due to an electron revolving in a circular orbit about a central nucleus Writing down the angular momentum of the circulating electron, taking the ratio of the magnetic moment to the angular momentum, and in terms of the quantum theory assuming the angular momentum to be an integral multiple of $h/2\pi$, we easily find in the simplest case that the magnetic moment of the Bohr magneton is $he/4\pi m$, which, by substitution of known values, gives the magnetic moment of the Bohr magneton as almost exactly five times that of the Weiss magneton The properties of a 'ring' electron, in which the revolving charge, instead of being concentrated at a point, is uniformly distributed over a thin anchor ring, have from time to time been discussed, and it is interesting to note that some of Schrödinger's recent results are strictly analogous to those obtained for this ring type of magneton

Langevin's classical paper of 1905 gave a basis for Curie's experimental generalisations concerning the behaviour with temperature of dia and paramagnetic bodies Again an appeal is made to classical methods The electron orbit behaves as a magnet and possesses a magnetic moment It is possible that, for a given molecule, these orbital moments give no resultant magnetic moment The application of a field which rises from zero to some final value, H, will cause a change in the magnetic moment which can be calculated on the assumption that an electromotive force is induced in the orbit, measured by the rate of change of the flux through it It is not difficult to show that this change is negative In a paramagnetic gas we have to deal with molecules which have a resultant magnetic moment, and, assuming an initial random distribution of the axes of these magnets, it may be shown that the application of a magnetic field results in the development of a magnetic moment giving a mass susceptibility varying inversely as the absolute temperature

So far the effect of any mutual molecular interaction has been neglected, but if, following Weiss, we assume the existence of a molecular field proportional always to the intensity of magnetisation, I, so that the total field is $(H+NI)$, we then obtain for the mass susceptibility the modified Curie law, which makes the susceptibility inversely proportional, not to T, but to $(T-\theta)$ But considerations of the Zeeman effect show that Langevin's original treatment of paramagnetism requires serious modification, inasmuch as we find that only certain discrete values can be assumed by the resolutes, in the field direction, of the atomic magnetic moments, and in order to resolve the difficulties of the situation it is necessary to endow the electron with an intrinsic spin and a magnetic moment

These elementary considerations and many more points of importance in modern theory are developed in the contributions made to the discussion by Dr E C Stoner and by Prof H S Allen

Prof C G Darwin discussed the polarisation of the electron The quantisation of the electronic orbit leaves unexplained certain finer phenomena which are covered by giving the electron itself an intrinsic spin, and now with the development of wave mechanics comes the notion that the electron can be considered as a polarised wave Prof Darwin considered in some detail the possibility of observing directly the magnetic moment of a *free* electron, as distinguished from the indirect verification observed by loading the electron with the core of a silver atom and subjecting the stream of atoms to the action of a non uniform magnetic field as in the experiments of Gerlach and Stern

Bohr has suggested that any experiment of this type carried out on streams of free electrons would necessarily give negative results, as the electrons would have uncertainties of position and speed which would blot out any systematic effect which we might hope to obtain Prof Darwin disagrees with this conclusion, based as it is on the assumption that the behaviour of the polarised electrons is observed by *one* magnetometer, whereas a survey of the magnetic field by several magnetometers may enable us to overcome the uncertainty

Mr W Sucksmith discussed some difficult experiments on the measurement, for ferro and para magnetics, of the gyromagnetic ratio—the ratio of the magnetic moment of the magneton to its angular momentum—a knowledge of which leads to an estimate of the Landé splitting factor g For the Dy^{+++} ion in Dy_2O_3 he finds for g the value $1\ 28 \pm 7$ per cent, the theoretical value being 4/3

Prof W Peddie's contribution dealt with the interrelations of magnetisation and temperature in crystals from the point of view of kinetic theory He showed that a good general account of the phenomena can be given by a reduced equation of state of the second degree Dr W L Webster gave an account of magnetostriction and change of resistance in single crystals of iron and nickel, showing that there are two

stages in the process of magnetisation which involve different distortions of the crystal

Dr L F Bates described some experiments on the temperature variation of the specific heat of manganese arsenide, which has a critical temperature in the neighbourhood of 45° C The hypothesis of an internal field, put forward by Weiss, leads to a definite shape for the specific heat temperature curve, and Dr Bates finds that while the general form of the curve is similar to that given by the Weiss theory the variation of specific heat with temperature is more nearly proportional to dI_s/dT than to dI_s^2/dT

Mr F C Powell dealt with the change in size of a ferro magnetic at the Curie point A rough estimate of its magnitude has already been made for iron on Heisenberg's theory, but the experimental values had been misquoted The present paper corrects this and also revises the theoretical estimate in the light of Heisenberg's modified theory The numerical values for iron and nickel are calculated and are found to be of the order demanded by the theory

Prof Weiss and M Forrel gave the results of an experimental study of the saturation data for a number of ferro cobalts and nickel cobalts and deduced therefrom the atomic moments of iron, nickel, and cobalt

The paper by Prof W Gerlach is an experimental study of the relation between certain electrical and ferro-magnetic properties Nickel is the substance under investigation and its change of resistance with temperature has been studied over a range which includes the Curie point The curves showing the variation with temperature of the *temperature coefficient* of the resistance are in very close agreement with the curves obtained by Weiss for the variation of specific heat with temperature Prof Gerlach further discusses the resistance change of nickel in a longitudinal field and describes a new thermo magnetic effect If a ferro magnetic body is placed in a homogeneous magnetic field, and a temperature difference is established between its ends, the lines of force of the field coinciding in direction with the line of temperature fall, an e m f appears between the ends of the body Prof Gerlach describes preliminary experiments on the variation of this e m f with variation of the temperature at the ends of the specimen

It need scarcely be said that Dr P Kapitza's account of his remarkable experiments in strong fields was full of interest, and it is not too much to assert that a technique which has placed in the hands of experimenters a method for developing fields of 300 kilo gauss in a volume of 3 cubic centimetres, even though the duration of the field be a hundredth of a second, represents one of the most important advances in experimental work that the last few years has afforded The magnification of the ordinary effects observed reaches such large values that the short space of time in which the effects are observable introduces no unsurmountable difficulties Thus the splitting of the lines in the Zeeman effect is so large that it may be observed by means of the ordinary prism spectrograph, and changes of electrical resistance which in ordinary fields require very special methods for their estimation are, in these large fields, increases of 20 or 30 per cent

The whole discussion was thoroughly enjoyable If it tended to show that modern magnetics, in some of its aspects, is still in a pre Newtonian stage, where it is dominated by

> "Cycle on epicycle, orb on orb,
> With centric and eccentric scribbled o'er,"

it has cleared up some difficulties, focused attention on others, and has certainly helped to systematise the ideas of many of those who were present

ALLAN FERGUSON

Utilisation of Potatoes

A PRACTICAL account showing how potatoes can be used most profitably at present prices is given in the *Scottish Journal of Agriculture*, vol 13, p 30 Both potatoes and oats have a high feeding value, and on farms carrying stock it is being found more economical to use them for food than to sell them The quantities that can be safely used, their relative food values and costs, are compared with those of other commonly used food stuffs, data from actual feeding experiments being quoted in support of the recommendations

Cattle can utilise potatoes raw, but for pigs they are better cooked, green or sprouted tubers should be avoided as they are liable to be harmful Since the protein and mineral content of potatoes is low, a supplementary ration such as separated milk and a mineral mixture is necessary for young animals or dairy cows On a ration containing a large proportion of oats and boiled potatoes so supplemented, young pigs gave as good gains, at lower cost, as when raised on other commonly used food stuffs

The question as to the best use to make of surplus potatoes is also discussed One of the chief difficulties lies in the fact that the surplus is a casual one, depending on seasonal conditions, although importation of foreign potatoes and overplanting contribute to the problem The possible uses, other than human consumption, to which potatoes can be put are various Feeding to stock, either whole or as silage is probably the simplest way of dealing with the surplus, but silage making needs further investigation and development in England Alcohol starch, acetic acid, or dried potatoes are successfully produced from potatoes on the continent, but so far little has been done in this direction in Great Britain The fluctuating supplies of raw material present a special difficulty in establishing such industries

Increasing the demand by selection for cooking quality rather than yield, increased export of seed, improved grading and better marketing, especially in early summer when imports are greatest, are further means by which the surplus may be reduced In fact, better organisation, together with a diversion of the surplus into channels other than for human consumption, is necessary to make potato growing in Great Britain remunerative and a trustworthy source of profit

New Short-Circuit Testing Plant

WE are glad to notice that the number of commercial testing laboratories in Great Britain is rapidly increasing As a rule these laboratories are not co operative but are set up by individual companies In the *Electrical Review* for May 30 there is an interesting account of a short circuit testing plant which has been erected by Messrs A Reyrolle and Co, of Hebburn on Tyne

The plant has the short circuit capacity of 1,500,000 kilovolt amperes and is the largest plant of this kind in Great Britain It is situated at Reyrolles' New Town Works between Newcastle and South Shields As large devices have to be tested, in some cases until they break down and are destroyed, and as huge amounts of electric energy are suddenly converted into heat, great precautions have to be taken to prevent fire Cylinders filled with carbon dioxide are stored in the transformer room The gas can be released by a switch in the control house or locally by hand and the machine and terminal pit are at once flooded with the gas

In one of the tests an oil tank containing a hundred gallons of switch oil was heated to 140° C It was ignited by means of wood and waste soaked in eighteen gallons of petrol and paraffin The tank was then upset, and after sufficient time had been allowed to elapse to ensure that the oil was well ablaze the test bay door was closed and the carbon dioxide was released by operating the switch at the control house The time that elapsed between the decision to close the door and the complete extinction of the fire was fifteen seconds After about five minutes the door was opened again and the smoke and gas were allowed to dissipate The damage done was negligible and consisted only in a slight blackening of the lamp shades, control switches, and other apparatus in the test bay

We congratulate Messrs Reyrolle and Co on having constructed what is practically an electric power supply station capable of giving for testing purposes an infinite variety of electric loads reproducing the equivalent of the momentary outputs of our largest power stations

University and Educational Intelligence

CAMBRIDGE —The Appointments Committee of the Faculty of Geography has reappointed Mr J A Steers, of St Catharine's College, to be University lecturer in the Faculty

J S L Gilmour, of Clare College, has been appointed curator of the Herbarium and Botanical Museum

The Council of the Senate has appointed Mr H M Combie of King's College, a member of the Consultative Council of University and School Science Teachers

D J Watson, of Downing College, has been reappointed to the Frank Smart University studentship in botany

A course of instruction in the technique of tissue culture will be given at the Strangeways Research Laboratory on July 1 29 Only a limited number of applicants can be received Notification from those wishing to take the course should be sent to Dr H B Fell, Strangeways Research Laboratory, Cambridge

EDINBURGH —Sir James Barrie has been elected Chancellor of the University, in succession to the late Lord Balfour

LEEDS -The foundation stone of the new library of the University will be laid on June 24 at 3 P M by the Lord Brotherton of Wakefield, donor of the library building, the Chancellor, His Grace the Duke of Devonshire, will preside

OXFORD —The report presented to Congregation by the curators of the Parks mentions the progress that has been made in labelling the trees, a most welcome and desirable addition to the opportunities afforded by the University for botanical study and observation

NINE scholarships, each of the annual value of £25, have been founded at the Constantine Technical College, Middlesbrough, by the Imperial Chemical Industries, Ltd Forms of application for the scholarships, returnable by at latest June 16, may be obtained from The Director of Education, Education Offices, Middlesbrough

THE Royal Commissioners for the Exhibition of 1851 have made the following appointments to Senior Studentships for 1930, the recommending body being given in brackets Dr J Farquharson (University College, London), for research in physical chemistry, Dr M Ritchie (Edinburgh), for research in chemistry, Dr L Rosenhead (Leeds), for research in aerodynamics and geophysics, Mr C P Snow (Cambridge), for research in physical chemistry

Two or three years ago Mr G H Bosch gave £222,000 to the University of Sydney for the establishment of chairs in the Medical School and for building and equipment of laboratories Announcement is now made by a Reuter telegram from Sydney that the Rockefeller Foundation, no doubt following its usual practice of supporting local benefactions, has agreed to contribute £100,000 to provide laboratory facilities at the University for the departments of surgery, pathology, bacteriology, and allied subjects

THE twenty first Annual Conference of the Association of Teachers in Technical Institutions is being held at Brighton on June 6–10, under the presidency of Mr H A Norman, head master, Junior Technical School, Bury An exhibition of apparatus and books will be held in the Royal Pavilion, Brighton, on June 9 and 10 Among the topics for discussion are liaison between Government departments concerned with education schemes, interchange of teachers, Yorkshire Council for Further Education National Certificates in building, university service and superannuation, Royal Society of Teachers, and junior technical schools

VACATION courses for teachers and students in England and Wales have been arranged by the Board of Education, local education authorities, university bodies, and associations of teachers and others, to be held this year, chiefly in July and August, in London (19), Oxford (11), Cambridge (6), Bournemouth, Brighton, Seaford, Folkestone, Herne Bay, Saltburn by Sea, Scarborough, Bangor, Aberystwyth, Barry, Malvern, and other places Particulars of these and of courses for teachers at Dundee, Glasgow, Aberdeen, and Edinburgh are contained in the Board of Education's recently issued pamphlet on the subject (H M Stationery Office, 6*d*) The sciences, especially biology and psychology, figure prominently in this prospectus The Brighton Education Committee, one of the six education authorities offering vacation courses has concentrated on biology to the exclusion of other subjects The course, on Aug 1–15, will be conducted by Dr W D Henderson, head of the department of zoology in the University of Bristol, and will include practical work and collecting in the field, with demonstrations on the material collected It is intended for teachers of biology who prepare pupils for the first and higher school certificate examinations Twelve university tutorial classes committees offer courses organised in connexion with the work of the Workers' Educational Association All except one include psychology in their programmes The Association of Women Science Teachers is holding a course in botany at Leeds and in chemistry at Bedford College, London Courses for foreign students are provided by the Universities of Oxford, Cambridge, and London (2), by University College, Exeter, the College of Preceptors, and the Regent Street Polytechnic, London For particulars of the arrangements by which British and foreign students attending recognised vacation courses in Great Britain can obtain reductions in railway fares on the British railways, application can be made to the National Union of Students, 3 Endsleigh Street, London, W C 1

Historic Natural Events

June 8, 1918 Nova Aquilæ.—On this date Nova Aquilæ III was discovered independently by a number of observers when it had suddenly become a conspicuous star. On June 9 its brightness nearly equalled that of Sirius, it then began to fade and eight days after its maximum it had decreased to one fiftieth of its maximum brightness, while eight months later it was invisible to the unaided eye. It was found that, during the thirty years prior to 1918, a faint star had been photographed many times in the place occupied by the Nova, a star which afterwards increased in apparent brightness about 30,000 fold within four days. Telescopically the Nova remains as a variable star enveloped by an expanding shell of nebulosity which, apparently originating at the time of the sudden brightening, spread outwards radially with great velocity and was first visible in large telescopes six months later. The early recognition of this Nova enabled a unique spectroscopic study to be made of it in the early phases of its outburst which, appearing to us in 1918, actually occurred about the eighth century.

June 9, 1888 Waterspout.—A peculiar funnel shaped cloud approached the village of Langtoft, Yorkshire, from the eastward, and burst over the hills to the westward. An enormous volume of water flowed down the hill, forming three parallel fissures in the chalk, in the deepest of which were four holes seven feet deep. The water then flowed into the village in a stream 40 feet wide and three or four feet deep, entering the houses and doing great damage, though no life was lost.

June 9, 1905 Luminous Cloud.—About three quarters of an hour after sunset a luminous cloud was observed over the greater part of New Zealand, probably the trail of a meteor. At first it appeared as a long streak, gradually becoming Z shaped. For more than twenty minutes it was brighter than the moon, then its glow became diffused and fainter, but it retained a glow equal to that of the zodiacal light for ten minutes longer.

June 9, 1910 Thunderstorms.—A series of violent thunderstorms occurred over England on June 7 and 9, 1910. On June 7 they occurred between 6.30 and 11.30 P.M., along a belt of country from Surrey to central Wales. On June 9 they occurred over the southern half of England and were accompanied by torrential rain and destructive hail which did enormous damage between Wheatley and Waterstock, about six miles east of Oxford. This storm began with a hurricane about 1 P.M., then about 1.15 P.M. hail fell in the form of large lumps of clear ice round a dull centre. It lay to a depth of about three inches on level ground, but was piled by the wind in heaps of two or three feet. The worst of the storm was over by 3 P.M., the depth of rain and melted hail being more than four inches.

June 10, 1886 Eruption of Tarawera (New Zealand).—Though for seven months there had been signs of activity, it was not until early on June 10 that the volcano broke into eruption, and a great cloud of smoke and vapour rose to a height of more than 8 miles and then drifted to the west. This was followed by a downpour of mud, water, and heavy stones that buried the country to a great distance from the volcano and destroyed the well known and uncommon natural feature of the district, the Pink and White Terraces.

June 11, 1928 Waterspouts.—On June 11, about 10.30 A.M. no fewer than five waterspouts were seen between the eastern point of the Isle of Wight and the coast of Hayling Island. They formed near the Nab, and drifted south south west until opposite Bembridge Ledge, where they dissipated.

June 12, 1731 Drought.—The journal of Etienne Azambourg, a farmer of Enfournet, Dept. du Cher, records in June that "There has been so great a drought this year that I do not believe I have seen a similar one, nevertheless the soil was easily worked because the frost had broken the ground, for there had been a long and severe winter which thawed without rain, ... but as it does not rain the corn will soon be lost. There is in France much bringing out of relics and prayers to Saints to obtain from God by their intercession tempests, and among others that of St. Jacques was brought here from Aubigny the 12th of this month." On June 26 he added: "On the 24th it has rained thanks to God as was necessary, this will soon make a harvest."

June 12, 1897 Great Indian Earthquake.—The Assam earthquake was felt over an area of about $1\frac{3}{4}$ million square miles, or half the size of Europe. Buildings were damaged over an area more than twice as large as Great Britain, while, within one almost equal in extent to Yorkshire, scarcely a house escaped ruin. The latter area showed many distortions such as fault scarps (one of which was 12 miles long with a maximum throw of 35 feet), rock fractures, and warping. This earthquake is noteworthy as being the first in which the two series of preliminary waves, primary and secondary, were distinguished on seismograms. For the first time, too, the long waves were observed to pass several stations a second time, having travelled to them through the antipodes of the epicentre.

June 13-15, 1903 Continuous Rain.—There was absolutely unbroken rain in London from 1 P.M. on June 13 to 11.30 P.M. on June 15, a period of $58\frac{1}{2}$ hours. This is the longest period of continuous rainfall on record in the British Isles. The rain was not especially heavy, the total amount being 3.44 in., but there was some minor flooding.

June 14, 1914 Thunderstorm.—A violent thunderstorm broke over south west London during the afternoon, accompanied by violent rain and hail. On Wandsworth Common seven persons were killed by lightning while sheltering under trees. In Richmond Park 3.70 in. of rain fell in $2\frac{1}{4}$ hours, and the neighbourhood of Kingston Station was flooded to a depth of four feet. At Wimbledon the District Railway was submerged by the bursting of a sewer and at Tooting Junction station the water was a foot deep on the platform. At Catford much damage was done by lightning and hail.

Societies and Academies

LONDON

Geological Society, May 14.—**Charles Barrington Brown**: The geology of north eastern British Somaliland. Geological results of four months' field work with the Anglo Italian Boundary Commission in Somaliland. The area discussed is a belt of country along the 49th meridian east, from the coast to about 80 miles inland. There are three structural units: (1) The sunken block or belt of the Aden Gulf bordered on the south by an important fault of 6000 feet throw, from the next unit, (2), the faulted upraised mass of the Al Hills, which continue as a bordering scarp along the south of the Gulf as the Aroru and Afaf Hills; on the south succeeds (3), the inland plateau region at 2000 to 3500 feet elevation. This plateau is entirely unfaulted, but has been subjected to folding of a peculiar kind, resulting in gently undulating areas, unaffected areas, and numbers of small synclinal basins the origin of which is obscure. The Jurassic and Cretaceous

rocks crop out on the face of the Al scarp fronting seawards The Lower Eocene forms all the surface of the Al Hills, a splintered block tilted to the south The Middle Eocene covers all the inland plateau There is a group of faults in échelon in the mountainous country, each with a throw of nil to 2000 feet in a short distance The Aden Rift Fault was traced for a distance of 48 miles

EDINBURGH

Royal Society May 5 —**R Crookall** Some curious fossils from the Downtonian and Lower Old Red Sandstone of Scotland These fossil types occur in association with remains of fishes, *Birkenia*, *Thelodus*, and *Lanarkia* (the first of which occurs in England) They have not so far been recorded from rocks of corresponding age in England Three types are recorded, the first, here named *Taitia catena*, being fairly common, while the remaining two are very rare It is not possible definitely to determine their systematic position Two of the types are probably algal in origin; the affinities of the third are quite uncertain —**A C Stephen** Studies on the Scottish marine fauna additional observations on the fauna of the sandy and muddy areas of the tidal zone The intertidal areas, the head of certain sea lochs on the west coast, and the sandy shores of some of the western isles have been examined The dominant species were the same as on the other parts of the coast Species showed the usual zoning, and these zones occurred in the usual relative order Unless sheltered, the sands on the western isles contain few animals —**E A T Nicol** The feeding mechanism, formation of the tube and physiology of digestion in *Sabella pavonina* The elaborate ciliary mechanism connected with the branchial crown whereby food is procured, consists of catching, sorting, receptive and rejecting tracts Some of the particles pass to the mouth, some are stored in the ventral sacs of the lateral lips to be used in adding to the tube, and the rest rejected via the palps The separation into three groups is dependent entirely upon size The anterior ventral glandular shields and the collar folds are concerned with building the tube An amylase, protease, and lipase have been detected in the digestive fluid and conditions governing their optimum activities determined —**R A Fisher** The distribution of gene ratios for rare mutations Correction and extension of the author's discussion in 1922 of the maintenance of genetic variability in species under the opposing influences of mutations tending to increase the variability and of selection tending to limit it The principal corrections are (i) that the time of relaxation for the decay of the variance in the absence of both mutations and selection is now shown to be $2n$ generations, where n is the number of the species breeding in each generation, (ii) the distribution of gene ratios for the variance maintained by mutations without selective advantage or disadvantage is modified to a form closely similar to that established under the action of selection The former method of differential equations is supplemented by a method using functional equations Exceedingly minute values for the selective advantage or disadvantage are shown to make a great difference both to the chance of success of a mutation and to the contribution of such mutations to the specific variance —**Miss F E Allan** The general form of the orthogonal polynomials for simple series with proofs of their elementary properties ξ_r is the polynomial of degree r in x, defined by the equations $\xi_0=1$, $S(\xi_p \xi_r)=0$ where summation extends over n given equidistant values of the variable x and p has in turn all integral values from 0 to $r-1$ The numerical method of curve fitting by orthogonal polynomials which has been developed by R A Fisher is based on a knowledge of the value of the terminal differences and is given in this paper, and from it have been deduced $S(\xi_r^2)$, the residual variance at any stage, and Tchebitchef's difference formula connecting three successive polynomials of the system By converting the terminal differences to central differences, and building up from these, a general form has been found for the polynomial of degree r of the orthogonal system, from which can be determined the explicit expressions for the polynomials These are given as far as ξ_{10}

PARIS

Academy of Sciences, April 23 —**Ernest Esclangon** The position of the celestial body supposed to be a trans Neptunian planet Four additional negatives were taken on April 15, 17, 19, and 20 the results of the calculations are given and compared with those worked out by Stoyko from observations on Mar 17, 31, and April 17 —**C Sauvageau** and **G Denigès** The sugar of the algæ (Florideæ) Criticism of a paper on the same subject by Colin and Guéguen —**Arnaud Denjoy** A class of analytical functions —**G Maneff** The principle of least action and gravitation —**P Swings** The variations of the relative intensities of the components of the doublets of rotation in the resonance spectrum of sulphur —**C Marie** and **C Haenny** The study of the ammonia oxygen battery The formation of nitrates and nitrites in the presence of alkalis —**Louis Glangeaud** The structure of the coastal regions of Algeria between Ténès and Philippeville —**Loeper, A Mougeot, R Degos,** and **S de Seze** The glycogen of the heart and cardiac medicines As regards glycogen, the drugs examined fall into two groups one class, such as acetylcholine and quinidine, conserve the glycogen, the other, such as adrenaline, tend to make it disappear —**Henri Coupin** The conditions of formation of the conidia and perithecium in *Eurotium repens* —**Raymond-Hamet** The action of hordenine in an animal which has received an intravenous injection of yohimbine chlorhydrate —**Alb J J Vande Velde** and **A Verbelen** Biochemical researches on earth Description of a new method for counting the micro organisms in soil —**A Policard** and **J Devuns** Histochemical researches on the mineral particles contained in the lungs of miners From the histochemical point of view the results obtained from the examination of seven lungs, four showing clinically no pulmonary troubles, confirm the results of MacCrae and of Watkins Pitchford and J Moir on the lungs of Rand miners The authors conclude that under the conditions of work in most coal mines, the distinction between anthracosis and silicosis is purely theoretical

ROME

Royal National Academy of the Lincei, Feb 16 —**Gino Fano** Spacial sections of the Grassmannian variety of straight lines of five dimensional space —**U Cisotti** Dynamic actions of translo circulatory currents round an arched strip —**A Russo** Nuclear dualism and sexuality in *Chryptochilum echini* Maupas The individuals of the two categories of this organism exhibit distinct sexuality, determined by the different quantities of nuclear substance, by the different dividing processes of the nuclei, by their different physiological powers, and by their different destinations The male sexuality, attributed to the *B* gamete, may be an elementary and primitive form of the gametic differentiation of living beings in general, since the micronucleus, having lost all germinative capacity, does not take part in the formation of the micronuclei of the two classes formed after conjugation —**A Tonolo** Intrinsic form of the equations of the equilibrium of elastic media (2) —**Guido Ascoli**

Further regarding the linear representation of continuous functions —**R Caccioppoli** Laplace's series A group of theorems on the convergence of the series developments of Laplace's functions Yn, in particular, two extensions to the spherical functions of Jordan's classical theorem on Fourier's series, are developed —**F Sbrana** The infinitesimal operation in the group of derivations — **G D Mattioli** The determination of the Riemannian varieties assumed by simply transitive groups of movements **M Brelot** The equation, (1) $\Delta u = c(x, y)u(x, y)c_{\sim} o$ — **A Gelfond** The development of entire functions of finite order in Newton's interpolation series —**N Théodoresco** Steps in a theory of the functions of a complex variable in the general sense (2) — **G Vranceanu** The conditions of rigidity of a Vm in an Sn — **E Pistolesi** A rapid method for the calculation of the dynamic effect of a translatory current on a cylinder in the neighbourhood of an indefinite plane wall A rapid method is given for arriving at the result obtained by Raimondi in his recent treatment of this problem - **G Supino** Further considerations on the choice between elastic solutions with equal resultants In a recent note, the conception of fundamental solution was fixed given an elastic solid bounded by the contour σ, this is divided into two zones σ_1 and σ_2, the distribution of forces (or of the displacements) on σ_2 and the resultant and the resultant moment of the forces on σ_1 being supposed given These data do not determine completely the elastic solution, so that the fundamental solution is taken to be that which, while satisfying the data, renders minimum the work of deformation The properties of such fundamental solutions are considered — **B Finzi** Power relative to a translatory circulatory current in which an arched lamina is immersed —**B Caldonazzo** Plane irrotational motions of perfect liquids in the presence of movable obstacles —**U Barbieri** Astronomico geodetic station of Eremo di Cherasco (2) — **A Quilico and M Freri** A new method of formation of pyrrole blacks (2) —**M Airoldi** The age of the andesitic eruptives of the island of Capraia The author s investigations indicate that these rocks belong to the lower Pliocene —**G Lincio** The artinite of Monte Ramazzo (Liguria) — **Giulio Cotronei** and **Aldo Spirito** Zoological constitution and grafting experiments with *Anura* and *Urodeles* - **G Mezzadroli and E Vareton** Action exerted by ultra short electromagnetic waves on the catalasic power of seeds Waves of 2 3 metres length emitted by a radio oscillator exercise a favourable action on the germination of barley and bean seeds, which exhibit increased catalase activity during the first few days of germination —**B Monterosso** Structure and function of the middle intestine of *Peroderma cylindricum* Morphological (and, perhaps, functional) duplicity, which has long been debated, is definitely established in the case of this organism, owing especially to the very marked differential characters which distinguish the forms of one cellular type from those of the other, and also to the clearness with which the initial cell - - the common source of both cycles— is presented

Official Publications Received.

BRITISH

N Z Department of Scientific and Industrial Research Bulletin No 15 Peach Culture Spraying and Manurial Experiments in the Nelson District. By K M Curtis and T Rigg Pp 22+4 plates Bulletin No 16 Cold Storage of Fruit Investigations conducted with Apples during 1927 and 1928. By L. W Tiller Pp 23+4 plates (Wellington, N Z W A. G Skinner)

Royal Botanic Gardens, Kew Bulletin of Miscellaneous Information, 1929 Pp iv+356+120+12 plates (London H M Stationery Office) 12s 6d. net.

Records of the Indian Museum (a Journal of Indian Zoology) Vol 32, Part 1, March Pp 64 (Calcutta) 2 12 rupees, 5s

British Engineering Standards Association British Standard Dimensions for Components of Optical Projection Apparatus (No 379 1930) Pp 11 (London) 2s net

Air Ministry Aeronautical Research Committee Reports and Memoranda. No 1203 (Ae 364) Pressure Distribution over a Yawed Aerofoil By D H Williams, with an Appendix on Rolling Moments on a Yawed Aerofoil by A. S Batson (F 2645) Pp 23+19 plates 2s 6d net No 1274 (Ae 470) Stresses and Strains in Airscrews with particular reference to Twist By R McKinnon Wood and W G A Perring (T 2770 and a) Pp 14+4 plates 9d net No 1286 (Ae 436) Records of the Lateral Motions of a Stalled Bristol Fighter Aeroplane with Slots upon the Upper and Wing Tips Experiments made in the Cambridge University Air Squadron By Prof B Melvill Jones Flight-Lieut C E Maitland and R P Alston (T 2818) Pp 8+28 plates 9d net No 1287 (Ae 392) The Flutter of Aeroplane Tails By R A Frazer and W J Duncan (F 2784 T 2791) Pp 27+1 plate 1s 6d net No 1292 (Ae 441) Stalled Flight Tests of a Moth fitted with Auto Control Slots and Interceptors By E T Jones Flight Lieut C E Maitland and Flight-Lieut W E Purdin (T 2886) Pp 8+2 plates 4d net (London H M Stationery Office)

Seale-Hayne Agricultural College, Newton Abbot, Devon Pamphlet No 31 Sixth Annual Report of the Department of Plant Pathology for the Year ending September 30th 1929 Pp 28 Pamphlet No 32 The Manufacture of Butter By W B V Tresidder Pp 21 (Newton Abbot)

Department of Scientific and Industrial Research The Investigation of Atmospheric Pollution Report on Observations in the Year ended 31st March 1928 (Fourteenth Report) Pp xi+6 (London H M Stationery Office) 3s 6d net

The Journal of the Royal Agricultural Society of England Vol 90 Pp 8+372+clxx+xh+29 (London John Murray) 15s

Education (Scotland). Report for the Year 1929 by the Director on the Royal Scottish Museum Edinburgh Pp 12 (Edinburgh)

Proceedings of the Royal Society of Edinburgh Session 1929 1930 Vol 50 Part 2, No 11 On Changes of Rock Temperatures and Irregularities of the Earth's Rotation By R W Wrigley Pp 153 165 1s Vol 50, Part 2 No 12 On a New Method of Measurement of Minute Alternating Currents By Dr D F Martyn Pp 166 174 9d (Edinburgh Robert Grant and Son London Williams and Norgate, Ltd)

The Journal of the Institution of Electrical Engineers Edited by P F Rowell Vol 68 No 401 May Pp 525 656+xxxii (London E F and N Spon Ltd) 10s 6d.

Department of Scientific and Industrial Research Report of the Water Pollution Research Board for the Year ended 30th June 1929 with Report of the Director of Water Pollution Research Pp iv+23+4 plates (London H M Stationery Office) 9d net

Ceylon Journal of Science Section C Fisheries Bulletins of the Ceylon Fisheries Edited by Dr Joseph Pearson Vol 4 Preliminary Account of the Results of Drift Bottle Experiments in the Gulf of Mannar By A H Malpas Pp 95+21 plates (Colombo Colombo Museum London Dulau and Co Ltd) 3 rupees

Transactions of the Ceramic Society Vol 29 No 5 May (Wedgwood Bicentenary Commemoration Volume Part 1) Pp 400+xxxviii (Stoke on Trent) Parts 1 and 2 30s

The National Physical Laboratory Report for the Year 1929 Pp v+298+15 plates (London H M Stationery Office) 11s net

Memoirs of the Geological Survey of India Palæontologia Indica New Series Vol 16 Upper Carboniferous Fossils from Tibet By Dr F R Cowper Reed Pp iv+17+4 plates (Calcutta Government of India Central Publication Branch) 3 6 rupees, 5s 9d

Survey of India Geodetic Report Vol 4 from 1st October 1927 to 30th September 1928 Pp xii+146+17 plates (Dehra Dun) 3 rupees 5s 3d

Paleontologiese Navorsing van die Nasionale Museum Bloemfontein Deel 2 Stuk 2 Fossiele Perde van Cornelia, O V S Deur Dr Ir E C N Van Hoepen Pp 11 24 (Bloemfontein)

FOREIGN

United States Department of the Interior Geological Survey Bulletin 811 C Indiana Oolitic Limestone Relation of its Natural Features to its Commercial Grading By G F Loughlin (Contributions to Economic Geology 1929 Part 1) Pp vi+113 202+plates 27 45 30 cents Bulletin 811 D The Rawlins Shirley and Seminoe Iron Ore Deposits Carbon County Wyoming By T S Lovering (Contributions to Economic Geology, 1929 Part 1) Pp ii+203 235+plates 46 50 10 cents Bulletin 811 E Tertiary Volcanic Tuffs and Sandstones used as Building Stones in the Upper Salmon River Valley Idaho By Charles H Behre Jr (Contributions to Economic Geology 1929 Part 1) Pp ii+237 248+plates 51 53 10 cents Bulletin 822 B The Granby Anticline Grand County, Colorado By T S Lovering (Contributions to Economic Geology 1930 Part 2) Pp ii+71 76+plate 6 5 cents (Washington D C Government Printing Office)

United States Department of the Interior Geological Survey Water Supply Paper 601 Surface Water Supply of the United States, 1925 Part 1 North Atlantic Slope Drainage Basins Pp vi+269 30 cents Water Supply Paper 605 Surface Water Supply of the United States 1925 Part 5 Hudson Bay and Upper Mississippi River Basins Pp. v+179 25 cents Water Supply Paper 617 Upper Colorado River and its Utilization By Robert Follansbee Pp xv+394+13 plates 65 cents Water-Supply Paper 636 C The New England Flood of November 1927 By H B Kinnison (Contributions to the Hydrology of the United States 1929) Pp iv+45-100+plates 2 14 Water-Supply Paper 636 D Surface Water Supply of the San Joaquin River Basin California, 1895–1927 By H D McGlashan (Contributions to the Hydrology of the United States 1929) Pp vi+101 168 10 cents Water Supply Paper 636-E Surface Water Supply of the Pacific Slope Basins in Southern California, 1894-1927 By H D McGlashan (Contributions to the Hydrology of the United States 1929) Pp vi+169-219 10 cents (Washington, D C Government Printing Office)

Contributions to the Genetics of *Drosophila simulans* and *Drosophila melanogaster* By A H Sturtevant, C B Bridges T H Morgan, L V Morgan and Ju Chi Li (Publication No 399) Pp v+296 (Washington, D C Carnegie Institution) 4 dollars

A new Method of estimating Stream Flow based upon a new Evaporation Formula By J A. Folse (Publication No 400) Pp xi+237+22 plates (Washington, D C Carnegie Institution) 5 dollars

Flora of the Hermit Shale, Grand Canyon, Arizona By David White (Publication No 405) Pp v+221 (55 plates). (Washington, D C Carnegie Institution) 2 50 dollars

Carnegie Institution of Washington Year Book No 28, July 1 1928, to June 30, 1929, with Administrative Reports through December 13, 1929 Pp. xix+105+459+2 plates (Washington D C Carnegie Institution) 1 dollar

Japanese Journal of Mathematics Transactions and Abstracts Vol 6, No. 4 Pp iii+319 362+9 24 (Tokyo National Research Council of Japan)

Methods and Problems of Medical Education (Sixteenth Series) Pp v+251 (New York The Rockefeller Foundation)

Proceedings of the United States National Museum Vol 76 Art 13 The Bryozoan Fauna of the Galapagos Islands By Ferdinand Canu and Ray S Bassler (No 2810) Pp 78+14 plates Vol 77 Art 10 A nearly complete Shell of the Extinct Tortle *Trachemys sculpta* By Charles W Gilmore (No 2833) Pp 8+3 plates (Washington, D C Government Printing Office)

International Hydrographic Bureau Repertory of the Technical Resolutions concerning Charts and Nautical Documents adopted by the International Hydrographic Conferences Pp 48 (Monaco) 50 cents

Report of the Danish Biological Station to the Ministry of Shipping and Fisheries 35 1929 By Dr A C Johansen Pp 110 (Copenhagen C A Reitzel)

Japanese Journal of Botany Transactions and Abstracts Vol 5, No 1 Pp v+132+80 (Tokyo National Research Council of Japan)

Report of the Aeronautical Research Institute Tokyo Imperial University No 59 The Analysis of the Sounds emitted by Aircraft By Jûichi Obata and Yahei Yoshida Pp 143-185+plates 4 17 (Tokyo Koseikai Publishing House) 1 20 yen

Mémoires de l Académie Polonaise des Sciences et des Lettres Classe des Sciences mathematiques et naturelles Serie A Sciences mathématiques Vol 1, 1929 The Ice Age in the Tatra Mts By Eugenjusz Romer Pp 254+16 plates (Cracovie)

Œuvres d Émile Godlewski Père Publiees par Ladislas Vorbrodt Vol 1 (1870-1890). Pp viii+599 (Cracovie Académie Polonaise des Sciences et des Lettres.)

Flora Polska Tom 4 Pp iv+177 (Cracovie Academia Polonaise des Sciences et des Lettres)

Bulletin of the Earthquake Research Institute Tokyo Imperial University Vol 8, Part 1, March Pp 90 (Tokyo)

Journal of the Faculty of Agriculture, Hokkaido Imperial University, Sapporo Japan Vol 24, Part 5 Kurzrüssler aus dem japanischen Reich Von Hiromichi Kôno Pp 158 242+2 Tafeln (Tokyo Maruzen Co Ltd)

Scientific Papers of the Institute of Physical and Chemical Research Nos 236 240 236 The Constitution of Carthamin, Part 1, by Miss Chika Kuroda, 237 The Constitution of Carthamin Part 2, β-Carthamidin Methyl Ether and its Synthesis by Miss Chika Kuroda 238 On the Structure of Iron Oxide prepared by the Autoclave Treatment by Tuminosuke Katsurai and Tokunosuke Watanabe 239 Über die katalytische Reduktion des Kohlenoxyds unter gewöhnlichem Druck, 4, Die Einflüsse von Berylliumoxyd Magnesiumoxyd Zinkoxyd und Cadmium auf den Kobalt Kupferkatalysator von Shinjiro Kodama 240 On the Spark Discharge between Concentric Cylinders in Air (Abridgement) by Takeshi Nishi and Yoshitane Ishiguro Pp 59 114+plates 4 13 (Tokyo Iwanami Shoten) 1 00 yen

Statens Meteorologisk Hydrografiska Anstalt Årsbok 9, 1927 3 Vattenstånden vid Rikets kuster Pp ii+21 2 00 kr Årsbok 10 1928 5 Hydrografiska mätningar i Sverige Pp 25+4 planscherna 3 00 kr Årsbok 10 1928 6 Aerologiska iakttagelser i Sverige Pp 87 3 00 kr Årsbok 11 1929 1 Månadsöversikt över väderlek och vattentillgång, jämte anstaltens årsberättelse Pp 99 2 50 kr (Stockholm)

Meddelanden från Statens Meteorologisk Hydrografiska Anstalt Band 5 No 4 Illumination from Sun and Sky in the Neighbourhood of Stockholm in 1928 By T E Aurén Pp 24+2 plates (Stockholm) 1 50 kr

Classified List of Publications Pp 207 (Washington D C Carnegie Institution)

University of California Publications in American Archaeology and Ethnology Vol 24 No 6 Peruvian Cumbrous Bowls By Isabel T Kelly Pp 325 341 (Berkeley Cal University of California Press London Cambridge University Press) 25 cents

Proceedings of the American Philosophical Society Vol 69, No 2 Pp 19 97 Vol 69, No 3 Pp 99 115 (Philadelphia.)

CATALOGUES

The Nickel Bulletin Vol 3 No 5 May The Marine Uses of Nickel Alloys Pp 137 176. (London The Mond Nickel Co, Ltd)

Early Navigators and their Voyages Shipbuilding Log Books Pictures etc (Catalogue No 525) Pp. 88+12 plates (London Francis Edwards Ltd)

Diary of Societies

FRIDAY, June 6

Geologists Association (at University College), at 7 30

SATURDAY, June 7

Geologists Association (*June* 7 *to* 10) (at Star Hotel, Helston).—A Study of the Coastal Geology between Marazion and Porthleven Cornwall

Oxford University Junior Scientific Club.—Dr G C Simpson Thunder and Lightning (Boyle Lecture).

Physiological Society (in Physiology Department, Edinburgh University).

TUESDAY, June 10.

Quekett Microscopical Club (at 11 Chandos Street, W 1) at 7 30 — R. H Stoughton The Cytology and Morphology of Bacteria, with Special Reference to *Bacterium malvacearum*

WEDNESDAY, June 11

Geological Society of London, at 5 30 —The late Dr H von Ihering Land Bridges across the Atlantic and Pacific Oceans during the Kainozoic Era.

Electroplaters and Depositors Technical Society — Round table Conference on Electroplating Problems

THURSDAY, June 12

Institution of Municipal and County Engineers (Northern Irish District) (at Corporation Gasworks, Belfast) at 3

Royal Society at 4 30 —Sir Sidney Burrard The Geographical Representation of the Mountains of Thibet —Prof E G Coker and G P Coleman Cleavage Tests in Timber —M C Johnson Experiments on the Exchange of Energy between Gas, Solid and Adsorbed Layer *in vacuo*

FRIDAY June 13

Royal Astronomical Society, at 5

Royal Society of Medicine (Ophthalmology Section) (Annual General Meeting), at 5 —T Thomas An Experiment in Keratoplasty

Physical Society (at Imperial College of Science), at 5 —E J Williams (*a*) The Induction of Electromotive Forces in a Moving Liquid by a Magnetic Field and their Application to the Investigation of the Flow of Liquids (*b*) The Motion of a Liquid in an Enclosed Space —Prof E V Appleton Wireless Methods of investigating the Electrical Structure of the Upper Atmosphere —Prof C R Darling A Simple Method of Showing the Modes of Vibration of a Wire —Demonstration by Dr H R Lang on A Modified Callendar Recorder for the Automatic Control of a High Temperature Oil Bath

Malacological Society of London (at Linnean Society) at 6

Royal Institution of Great Britain, at 9 —Prof H Clay Unemployment.

Oxford University Junior Scientific Club —N Ashbridge The History of Broadcasting in this Country

PUBLIC LECTURES

FRIDAY, June 6

University College Nottingham at 7 —Prof A Einstein Lecture (in German) —Dr H L Brose An English Rendering of Prof Einstein s Lecture In chair Prof H H Turner

THURSDAY June 12

Institute of Pathology and Research, St Mary s Hospital Paddington at 5 —Col L W Harrison The Development of the Modern Treatment of Syphilis

CONGRESSES

June 4 to 9

Royal Institute of Public Health (at Portsmouth)

Friday, June 6 from 9 30 a m to 1 —Dr C K Millard and others Discussion on The Slum Problem

Dr C O Stallybrass Variations in Virulence during the Course of Epidemics

Col R J Blackham Acid Milks in Health and Disease

Brig Gen J Charteris The Design and Requirements of Slaughter houses

A Moore Hogarth The Rat Menace

W Buckley National Health and our Milk Supply

Surg Commdr H D Drennan and others Discussion on The Health of Dockyard Workers

Dr H M Vernon New Methods of Heating Buildings and their Influence on Comfort

Dr R P White Sensitisation of the Skin

Dr Letitia D Fairfield and others Discussion on The Slum Child

Miss Doris M Odlum Home and the Adolescent

W Clarke Hall The Problem of the Delinquent Child

Miss B M Johnson The Hygiene of the Domiciliary Labour Room

Dr Olive B Sharp Ante Natal Treatment in Connexion with Venereal Disease

Dr J Watt The Provision of Institutional Treatment for the Tuberculous

Dr R R Trail The Results of Sanatorium Treatment Immediate and Ultimate

Dr Rollier The International Factory Clinic for Indigent Patients suffering from Surgical Tuberculosis

Friday June 6, from 10 a m to 1 —Squadron Leader A F Rook Sanitation in Desert Operations

Surg Commdr T A O Flynn The Control of Malaria at H M Naval Base, Singapore

Surg Capt T M Morris Recruiting—Review of Modern Requirements

Wing Commdr H A Treadgold The Conditions of the Heart found in Recruiting

Dr G C Low Climatic Bubo—Its Diagnosis and Treatment

June 6 to 10

Association of Teachers in Technical Institutions (at Brighton)

Monday, June 9 (in Royal Pavilion), at 10 a.m —Induction of President — H A Norman Presidential Address

June 10 to 13

International Society of Experimental Phonetics (at Bonn)

June 16 to 25

World Power Conference (at Berlin)

SATURDAY, JUNE 14, 1930

CONTENTS.

Editorial and Publishing Offices
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Social Science Teaching *

THE position of the teacher in any field of study becomes constantly more difficult and onerous as the years pass and as the accumulations of knowledge become greater and we hope richer, and as the proper scope and methods of further study and research become daily more intricate and urgent and harder to define or embody in graduate or postgraduate curricula The accumulations of knowledge do indeed increase, but progress is often slow and tortuous and much has to be thrown into the discard under processes of selection more or less ruthless and impartial, for what is sound and apparently unquestionable knowledge to one generation may appear to the next as perfectly untenable Nevertheless, the net result in most directions and during the past half century is steady advance, especially and most remarkably in the physical sciences In the social and moral sciences the acquisition of real and durable knowledge is more difficult to evaluate and sort out from a great mass of questionable matter, hazy hypotheses, and unfounded opinion, but here also there remains, after these necessary deductions, a solid residuum of accumulated fact and sound deduction For the teacher in moral and social philosophy the main difficulties are to discover the solid ground in a country where treacherous swamps and shaking morasses abound, and to guide and stimulate his students to follow the right path and strike out new ones of their own, to strengthen and consolidate existing positions, and establish new ones

The main burden or central core of Prof Wallas's Huxley Memorial Lecture seems to have been precisely this How to stimulate original constructive thought in social science studies, and in particular how best to enable the postgraduate student to make the right use of academic opportunities to enable him, if not to furnish immediately valuable contributions to knowledge, at least to find the right path to that ultimate end But before arriving at this central theme Prof Wallas traverses wide and varied territory and touches lightly on many matters of particular interest and importance At the very outset, however, there may be some dissent from his view that the physical sciences have been the strong, and the moral and social sciences weak, and that this difference between the two branches was well exemplified in the events of 1914–18 Possibly this was not meant to imply that the physical sciences show their

* "Physical and Social Science By Prof Graham Wallas (Imperial College of Science and Technology Huxley Memorial Lecture 1930) Pp 16 (London Macmillan and Co, Ltd, 1930) 1s net

strength predominantly in war and the moral sciences their weakness as a factor in the cause of peace; but on the face of it there seems to be a tendency here to uphold the ancient fallacy that science, especially physical science, has been ever more prone to offer its services to the gods of war than to the embassies of peace. Be this as it may, it is doubtless much more important, in considering the relations and differences between the physical sciences and the social or moral, to investigate thoroughly the remarkable way in which progress in physics and chemistry has profoundly altered those social and economic conditions which it is the purpose of social science to study.

This is the dominant fact of the present age: discovery and invention in physics and allied studies have proceeded at such a remarkable pace that the sociologist and statesman have probably been unable to make the necessary adjustments quickly enough, or have made false adjustments, and have been, generally, very much at sea as to the true fundamental tenets of their own somewhat tottering and unstable social sciences. This uncertainty or weakness, as also the strength of the physical realm, may best be shown in war or under the conditions which lead up to war, but this of course does not mean that the physicist is on the side of the militarist. In any comparison of the social and physical sciences the truest and happiest line to take is that which leads to the view that the dominant and fundamental facts in sociology are to a very large extent physical. It is becoming clearer every day that politics and economics are inseparable, that the former indeed is now mainly concerned with economics, that the older term, political economy, was much truer than the new one; and it is still more clear that the principal data in economics rest on a physical basis. The modern statesman therefore has to take a constantly wider view, more especially of the advances made in physical science and discovery.

Another point of comparison between the physical and the social or moral lies in the remarkable possibilities of introducing experimental methods into the study of the social sciences, an idea which occurred to Bentham and still more emphatically to Mill. Modern economic history is indeed one continuous programme of large-scale experiment, more or less consciously devised, of which Italy to-day is perhaps the most outstanding example, closely followed by many other countries. The conditions and results of these experiments, so far as ascertainable, are being closely studied, for example, by the International Labour Office at Geneva and by the principal universities and schools of economics throughout the world, and the student of the social sciences has, if he searches diligently and fervently, an abundance of material of absorbing interest on which to work and speculate and exercise all his powers of logical reasoning, of induction and deduction, and sufficient also to stimulate and develop all his imaginative and emotional powers, for purely intellectual exercise without these latter—if such cold and isolated working of the mind can in any way be conceived as possible—is quite useless. Prof. Wallas does well to stress this point, and surely when he did so he had the shades of the great Huxley and of the still greater Mill solemnly visible to his mind's eye if not actually visible aloft there in the dim recesses of the ancient lecture hall.

Emotion! To the trained intelligence allied with the sympathetic heart is there not enough, in the present condition of mankind in this his earthly environment, to stir the imagination and the feelings to their highest and deepest? Who of us can look abroad upon the world, upon its present social and economic and political structure and workings, without strange stirrings in our inmost being, without high hopes, deep anxieties, strong faith that right and good will ultimately prevail, and stern determination and indomitable will that they shall prevail. To the most distinguished professor of the highest rank, to the humblest of obscure research students, no work will appear unduly laborious, trifling, uncongenial, or vain when this great end is kept faithfully in view, the end described by Friedrich List as *Pour la patrie et l'humanité*, wherein nationalism brought to its highest and best is ultimately merged in internationalism and the commonwealth of nations.

In the teaching of the social sciences, then, as Prof. Wallas insists, it is necessary to realise fully the force of the emotional in scientific study and research, and we are accordingly faced with the old and universal desideratum in all teaching, an integrated development of all the faculties, both of thought and feeling, although of course thought and feeling, even if separated in name, cannot be separated in act and being. There are many difficulties in realising the ideal under modern conditions, especially for the postgraduate student engaged in more or less original research in the social sciences; and one of these difficulties arises from the scale of modern education and the almost complete impossibility of getting that close and personal contact between professor and student which was so helpful in an older and smaller and

less strenuous academic world Prof Wallas appears to suggest that doctorates should be made somewhat more difficult and involve at least a longer course of study, but the mere lengthening of the course of study by one or more years would not in itself be necessarily desirable or productive of the looked for result In the course of his lecture he introduces, very unobtrusively and lightly, a suggestion that the student should try, at least from time to time, "to turn the flaccid pages of his notebook into something that a news paper critic might regard as decent literature" Here indeed is a practical suggestion that might bear fruit scientific literature generally, from a purely literary point of view, has not maintained that splendid standard set up by Mill, Adam Smith, Huxley, and other giants of a former age The student of social science to day may doubtless find it very difficult to approach that standard, but, equally doubtless, he will find it wonderfully helpful and interesting to try, and he too, more than many, has themes enough—absorbing, thrilling, passionate—to stir him to the attempt

W G L C

Embryology and Recapitulation

Embryology and Evolution By G R de Beer Pp viii + 116 (Oxford Clarendon Press, London Oxford University Press, 1930) 5s net

THIS little book is from the pen of Mr de Beer, who is one of the more brilliant of the younger Oxford men Its aim is to "dethrone the theory of recapitulation", to persuade us that the development of the individual throws no light on the past history of the race, and that therefore Ascidians need not necessarily be descended from a free swimming vertebrate even though they begin their lives as tadpoles

It is, we believe, the custom amongst brilliant Oxford men to fight for 'lost causes', and surely no cause was ever more hopelessly lost than this, for the doctrine of recapitulation is one of the most securely based inductions of zoology and every year brings additional confirmations of it to light

It is interesting, therefore, to see how Mr de Beer sets about his task Since the history of the race can only be deduced from a study of comparative anatomy, palæontology, or embryology, Mr de Beer must have independent knowledge of what this history was before he can say that embryology does *not* give a true account of it But palæontology is only available in a few cases in which the lineage series is fairly complete, and from the study of these cases it has come about that palæontologists are amongst the strongest supporters of the doctrine of recapitulation Comparative anatomy, so far as it can be legitimately used to give correct information as to phylogeny, is also a strong support of the theory—for comparative anatomy can only take us back a very short way If we strive to penetrate the veil of the past by the comparative anatomy of living adult forms, we soon arrive at a stage where all is wild speculation and fancy But where the type of structure is constant in a well defined group and an abnormal genus occurs within this group, the young stages of that genus have the typical structure of the group, and this is the solid foundation of the recapitulation theory

Mr de Beer's method is to select some embryo or larva and then to point out that it is difficult to imagine that it could have exactly resembled an ancestor But no one, least of all Haeckel himself, who put forward the theory of recapitulation, ever contended that the ancestral record had suffered no secondary modifications Most of Mr de Beer's cases are old and well known ones with which we have fully dealt in our "Textbook of Invertebrate Embryology", in this book the reader will find the causes and nature of these secondary changes fully discussed and we shall not waste the time of readers of NATURE in further elucidating them here But Mr de Beer's reading has been singularly defective for example, he credits Garstang with having been the first to direct attention to the affinity between the echinoderm larva and the larval stages of vertebrates The facts are that the tornaria larva of *Balanoglossus* was mistaken for an echinoderm larva when it was first discovered, and when Bateson, from embryological data, showed the vertebrate affinities of *Balanoglossus*, the connexion between echinoderm and vertebrate phyla was suspected at a period when Prof Garstang was still at school A solid basis for the theory was only afforded when the embryology of *Asterina gibbosa* was worked out in 1896

Mr de Beer lays great stress on a few cases where the palæontological record seems to contradict the evidence of embryology One of these is the structure of the ammonites, for these extinct molluscs carried their life-history around with them written on the inner coils of the shell In some cases these inner coils are ribbed and the outer coils plain, but in the majority of cases the inner coils are plain and the outer ribbed It is argued that, whether evolution proceeded from ribbed to plain or vice versa, one of these records must be wrong But the strong probability is that

both of them are correct For the ribs on an ammonite's shell are not mere ornament They are hollow corrugations which give strength to a shell otherwise too thin to afford adequate support Now thinness or thickness of shell is dependent on the abundance of the supply of calcareous matter if a thin-shelled form wandered into a region where there was plenty of lime its shell would be thickened, and the corrugations would become functionless and disappear, whilst a species with a plain shell would find it necessary to introduce corrugations, if the supply of lime became deficient

A great test of the soundness of a theory is whether or not it can predict results the truth of which will afterwards be independently confirmed Two examples of this may be briefly alluded to here The tympanic bone in mammals was considered on the evidence of the comparative anatomy of recent species to be the equivalent of the quadrate of reptiles, which is frequently curved round the auditory opening The embryological evidence suggested that the quadrate of reptiles had been changed into the incus bone of the mammalian ear Now from Africa a series of skulls have been discovered showing every stage in the transition from quadrate to incus Again, the palæontological evidence makes it clear that the five fingered hand of the land vertebrate must have been derived from the fin of the Devonian crossopterygian fish Steiner, working on the embryology of the wing of the bird, arrived at the conclusion that the fourth finger represented the axis of the fin and that three rays on the preaxial side corresponded to the thumb and first two fingers, whilst the little finger represented a single postaxial ray The same conclusion was independently arrived at by palæontologists studying the fins of the latest crossopterygian fish and the hands of the earliest land animals

Mr de Beer commits an amusing error when he says that the symmetrical stage in the development of the hermit crab does not represent its adult ancestor but the *larva* of the crab from which it is derived. There is no close affinity between so called 'hermit' crabs and true crabs, and the former are related to the Galatheidæ, which when adult have well-developed symmetrical abdomens like those of the young hermit crab

It might be asked what motive induced Mr de Beer to embark on this errand of hopeless knight-errantry We are not left in doubt as to the cause It is an attempt to support the gene-mutation theory of evolution, which is totally irreconcilable with the recapitulation theory, a fact which Morgan himself has recognised Now supporters of the recapitulation theory freely admit that mutations constitute an important set of biological phenomena they know that when mutations are crossed with the type segregation occurs, and it is clear that the study of these abnormalities is of great importance to all interested in cultivated plants and domestic animals They doubt very much if any additional light is thrown on the nature of mutations by inventing imaginary causes called genes to account for them but they are perfectly certain that genes are not units out of which the hereditary powers of an animal are built up that, on the contrary, genes represent the effects of external damage to these powers, as the experiments of Miller have clearly proved, and that therefore genes have played no part in evolution A prominent geneticist said, in discussing the results of Miller's experiments, "The mutation theory of evolution is dead"

Mr de Beer's original contribution to the discussion of embryology is to employ the terms 'pædomorphosis' and 'gerontomorphosis' for two supposed types of evolution By the latter, he means changes occurring relatively late in life-history which result in an improvement in an existing organ by the former, changes suddenly occurring in the earlier stages by which the whole trend of evolutionary history is altered and a new phylum springs into being

We shall briefly sketch the origin of the Gastropoda according to the recapitulatory theory and to pædomorphosis and appeal to readers of NATURE to decide between them According to the first theory the original mollusc was a bilaterally symmetrical animal which glided over the mud by means of its ventral cilia and was able to keep its body on an even keel But when it took to crawling over hard ground its humped back, which was protected by the shell, gradually sagged to one side and this caused one side to be stretched and the other to be crushed the stretched side grew more quickly than the crushed side, and thus was initiated that inequality of growth which not only gave rise to the spiral shell of the gastropod but also twisted the anus round to the front of the neck This change, which must have taken ages to produce, was already complete in the Cambrian 400,000,000 years ago—it was a change in adult habits and structure, but it is now pushed back by tachygenesis until it occurs during the free-swimming stage of the larva

According to pædomorphosis, the gastropod owes its origin to the occurrence of a sudden and miraculous 'mutation' in the larva by which at one fell swoop it twisted its visceral hump and shell through

an angle of 180 degrees By this fortunate miracle it now became able to protect its ciliated band or velum by withdrawing it within the shell, which it previously was unable to do, and so it survived whilst all its neighbours perished (Incidentally we may remark that the Lamellibranch veliger, which has its anus and mantle cavity behind, is nevertheless able to withdraw the velum within the shell)

The mutation theory of evolution—or evolution by sudden jumps—was first put forward by Bateson in 1894 When Haeckel attended the International Congress of Zoology held at Cambridge in 1898 this theory was discussed and Haeckel's pregnant criticism was, If this sort of theory is to be put forward for acceptance it would be better to return to Moses at once" E W MACBRIDE

Universities of the British Empire

The Yearbook of the Universities of the Empire, 1930 Edited by Sir H Frank Heath Published for the Universities Bureau of the British Empire Pp xv + 840 (London G Bell and Sons, Ltd, 1930) 15s net

THIS super calendar of the seventy universities of the British Empire is packed with every kind of information about them likely to interest the learned world, government departments, clubs, and the public generally Who's where in those universities is here ascertainable with a minimum of trouble likewise who's who so far as concerns appointments and degrees held by professors and other university teachers and the university by which each degree was granted The personnel of each university is exhibited in such a way as to show at a glance the strength of the staff employed in each field of learning Following this directory is a summary account of the equipment of libraries, museums, laboratories, etc, of the university, the degrees, diplomas, and certificates which it confers, its composition fees, scholarships open to graduates, residential accommodation, extra mural work, publications, and, finally, a summary of events of outstanding interest which occurred during the past academic year, with statistics of the numbers of students in attendance and degrees conferred Brief notes concerning the university's origin, the salient facts of its history and its constitution, are prefixed to this summary in many cases, but in others particulars of the university's early history, which appeared in last year's issue, have been replaced by a note—" For early history see the Year book for 1929" In chapters introductory to the sections dealing with the universities of Great Britain and Ireland, of Canada, of Australia, of South Africa, and of India, respectively, their common history, regulations, and practice are summarised

Appended to these sections are accounts of the conditions governing admission to various professions and careers for which university studies are a fitting preparation, matriculation examinations and admission of students from abroad into the universities in the British Isles, lists of post graduate scholarships, etc, and lists of centres of scientific research and of scientific information, whether connected with universities or not, to which independent research workers are admitted

A noteworthy feature of the present issue is the skilful marshalling of the information collected concerning the facilities available in the British Empire for scientific research in all its principal branches, and the aids available in every country for post graduate students and research workers of British citizenship irrespective of the place of their education those open only to graduates of particular universities being particularised in the appropriate sections of the main part of the book Such a comprehensive survey, which Sir Frank Heath, with his experience of work in the Department of Scientific and Industrial Research, was peculiarly well fitted to undertake, has not hitherto been published and was overdue

The 'Yearbook' lacks tables of comparative statistics So far as Great Britain is concerned, the inclusion of such tables would, it is true, have involved a duplication, though not necessarily a wasteful duplication, of a service already undertaken by the University Grants Committee As regards the other parts of the Empire, the absence of comparative statistics is to some extent justified by considerations set forth on page 6 of the introductory chapter on the universities of Great Britain and Ireland, wherein an estimate of the number of full time students (48,600) is qualified by the remark that the figures do not include the students of the institutions other than universities and university colleges in which professional education of university grade is given in theology, teaching, agriculture, etc, nor students reading privately for the external degrees of the University of London (this makes the more noticeable the absence of statistics of those degrees), for the bar, etc "This makes comparison with statistics of other countries difficult, as does also the fact that the work of the higher forms of many of our secondary and 'public' schools corresponds with the earlier stages of the work done in colleges and

collegiate departments of some foreign universities, e g in America " Despite these drawbacks, the following table summing up certain of the statistics given in the Yearbook " is not without interest The figures for the French Canadian universities appear to include a large proportion of students engaged in work of pre matriculation standard, and their degrees (baccalauréat) do not correspond to any of the English degrees

	Full time* Students	First Degrees
Canada		
Toronto	6 422	839
McGill	3 191	343
4 western provincial universities	6 804	766
3 French universities	9 774	407
12 other universities	6 457	795
Canada totals	32 648	3 150
Australian universities (6)	6 390	1 031
New Zealand	1 868	400
South African universities (4)	5 830	902
Indian universities (17)		13 248
819 American universities and colleges excluding pre matriculation departments and 155 603 law medical dental theological pharmacy and engineering students	Enrolled students in 1925-26 both full time and other 611 660	

Close co operation between the parts of the British Empire is an ideal which innumerable public speakers and writers constantly proclaim What more promising field for such co operation could be found than the learned world and what more indispensable documentary aid to co operation in this field than the Universities Yearbook ? Yet we are told in the preface that the sales are so comparatively small that the annual deficit incurred in respect of it has been very heavy and the Universities Bureau has, in consequence, been constrained to raise its price from 7*s* 6*d* to 15*s* The new price cannot be called excessive when compared for example with the price of Minerva , but one regrets that the increase should have been necessitated by the inadequacy of the Bureau s income

* The number of *part time* students is not given in all cases In universities in Canada Australia New Zealand and South Africa for which their number is given there were 11 359 as compared with 29 791 full time

A Logical Course of Elementary Physics

Physics By W J R Calvert (General Science Series) Part 2 *Sound* Pp vii + 142 3*s* Part 3 *Light* Pp vii + 202 3*s* Part 4 *Magnetism and Electricity* Pp x + 333 4*s* (London John Murray, 1929)

THESE three books are worthy successors of the author s mechanics and heat—the first of the series—which was published in 1924 Mr Calvert is well known as a teacher of teachers, and no one who instructs the young in the elements of physics can afford to ignore these volumes, whatever conclusion he may reach as to the desirability for their use by his pupils

Obviously the outcome of long and thoughtful experience, the books are, in a sense, too good, for they read almost as if they were taken down by a stenographer as the lectures were delivered and it is to be doubted if text books should read like the spoken word The movement is sometimes too slow too logical and perhaps too laboured Yet this is not always so for on the twentieth page of the volume on light we find Our present views have returned somewhat to the Newtonian view, except that in the place of corpuscles we have quanta of energy associated with the idea of a periodic electro magnetic disturbance There after that volume trips more lightly and the going is made easier by the relegation of lens formulæ and details about practical work to appendices at the end of the book

The design of the author has been to give a physical basis to the subject and his treatment throughout the series has been as devoid of mathematics as is reasonably possible In this he has been very successful in the volume on sound which, being full of interesting practical applications, holds the attention of the reader The chapters on reflection here are very good

In some respects, the book on magnetism and electricity is the most interesting of all Many, perhaps most, teachers prefer to start from some point within the pupils ken batteries ammeters, electric bells, and the like Not so the author, who only allows his readers to reach these things after a logical and lengthy journey Whether they will have acquired a thirst for more knowledge by that time may be doubted, but there is no doubt at all about the skill with which the route has been mapped out Those who insist on the logical development of ideas for the young will find it to perfection here Starting with only just sufficient magnetism for his purpose the author deals immediately with current measurement, and then by an easy transition passes to electrostatics, where he wisely avoids the usual system of units Then follows—too soon, as some will think—a chapter on the structure of the atom, after which potential measurement is introduced by the heating effect of current, when at length the way to Ohm's law is opened up, and all is plain sailing again

If the author has chosen a hard route, he has at least made it as easy as possible by avoiding un

necessary difficulties, as for example the measurement of magnetic moments and the use of the tangent galvanometer, which can be found by the morbidly curious in appendices at the end of the volume An excellent chapter on rays adds to the interest of the book, and there is an admirable preface, which provides food for the teacher, if not for the taught

Miers' Mineralogy

Mineralogy an Introduction to the Scientific Study of Minerals By Sir Henry A Miers Second edition, revised by Dr H L Bowman Pp xx+658 (London Macmillan and Co, Ltd, 1929) 30s net

THE first edition of this book appeared in 1902 It was clearly written, admirably illustrated by drawings and photographs, and it soon became a standard text book on the subject of pure mineralogy The editor of the second edition, who is also Sir Henry Miers's successor in the chair of mineralogy in Oxford, has added to the illustrations, brought the text up to date where necessary, adding a new chapter on the investigation of crystal structure by means of X rays, but has retained the original text so far as possible

In the main, this plan has been successfully carried out, and it is perhaps only in the 'Introduction' that there has been a too strict adherence to the original In the body of the text full justice is done to the recent advances in the study of crystal structure, but in the 'Introduction' it is barely mentioned, with the result that some passages, which in the first edition were remarkable forecasts of possible developments, are now almost out-of date, so nearly have their prophecies been fulfilled

The additions to the text, including 63 new figures, amount to 74 pages, of which 22 are devoted to the new chapter on crystal structure, and further pages in the descriptive part of the book give explanations of the structure of diamond and graphite, blende and wurtzite, α- and β quartz

It is not to be supposed that the relatively small additions to the text indicate either lack of progress in mineralogy or want of thoroughness on the part of the editor Much that has been done for the advancement of mineralogy within the last twenty-eight years lies outside the scope of the book, which was clearly limited by the author to the 'essential' properties of minerals and the means by which they are investigated In the description of the 'essential' properties of minerals, apart from the determinations of crystal structure, there is little new matter which can find a place in a text book The generally accepted system of classification has remained unaltered and work on systematic mineralogy has been devoted to the perfection of measurements and chemical analyses, and to the description of new minerals most of which are too rare to be included in a book intended for students In the improvement of methods by which the properties of minerals are investigated there is much that is new that might have been introduced had space permitted There are, however, many good text books to which students can be referred for recent developments in petrographic methods, in the use of the 'universal' stage of Fedorov, and in the study of polished plates of opaque ores, and by deciding to omit descriptions of these methods the editor has left us with a text book which is not only reasonable in size but also eminently readable

The printing of text and figures has been admirably done, and the price is not excessive for a book of this size

Our Bookshelf

Ions, Electrons and Ionizing Radiations By Prof James Arnold Crowther Fifth edition Pp xii+353 (London Edward Arnold and Co, 1929) 12s 6d net

THE appearance of a fifth edition of Prof J A Crowther's well known book, which gives in a simple form a comprehensive and systematic treatment of an important range of experimental physics and its interpretation, has been necessitated by the progress of research during the past five years The author's object has been to preserve the point of view of the book in relation to scientific thought, and the alterations effected are of a minor character, among the most important additional sections are those dealing with Aston's work on the packing effect, the Compton effect and theory of X-ray scattering, the work of Davisson and Germer and of Thomson on the diffraction of electrons by a crystal, Millikan's discovery of cosmic radiation, and the magneton together with the experiments of Gerlach and Stern New and improved photographs by Wilson of the tracks of ionising radiations replace the earlier ones The alterations have resulted in an enlargement of the book to the extent of about 24 pages

As pointed out by the author, the task of selection from new and old material has not been easy In a work of this type the quantum theory must necessarily play a prominent part in an interpretation of the experimental basis of physics, the section on the quantum theory is, however, unchanged, and a reader otherwise unaware of the present position would scarcely suspect the epoch making changes through which this matter has been passing A few lines only are devoted to the

new wave theory of the electron in connexion with the work on electron diffraction mentioned above Sections dealing with the magneton and the electron theory of conduction include no mention of the spinning electron and Sommerfeld's work on the theory of conduction with the help of the Fermi-Dirac statistics

Though the author has deemed it advisable to refrain from introducing matter which is at present somewhat speculative, the more advanced reader will be pardoned a feeling of regret that the results of some of the immense ranges of recent research have not found a place in the new edition

N M BLIGH

Artists in String String Figures, their Regional Distribution and Social Significance By Kathleen Haddon (Mrs O H T Rishbeth) Pp x + 174 (London Methuen and Co, Ltd, 1930) 6s net

MRS RISHBETH has long been known as a zealous collector and student of the string games known popularly as 'cat's cradle' In this volume she justifies a study which, to the Philistine, may seem puerile, by indicating its bearing upon the problems of cultural anthropology, showing on one side that these string games, especially in their more complicated forms, represent an expression of a creative or artistic impulse, and, on the other, give the student certain quite specific pieces of information about the environment and social facts in the life of the people among whom they are found The games are here described according to their geographical distribution, five games being taken from each group

Although more than eight hundred games are known, there are many and striking gaps in our knowledge Yet when due allowance is made for this, the first remarkable fact to emerge is the peculiar geographical distribution of the games While the string figure is widely distributed, occurring in North America, probably South America, though the Guianas at present furnish the only record, Africa (at present sparsely), Australia and Oceania, yet Eurasia is practically a blank space The author, therefore, concludes that while the Eskimo, redskins, tropical browns and blacks, have these figures, the white, yellow, and Asiatic brown people have practically none

The subjects also are curiously distributed, or perhaps more correctly show curious absences In West Africa, for example, no figures represent big game Mrs Rishbeth suggests that these absences may conceal interesting evidence as to native ways of thought, and in any case call for further investigation Mrs Rishbeth's suggestive treatment of her fascinating subject cannot fail to stimulate further collection which may bring the information desired

An Inorganic Chemistry By Prof H G Denham Second edition Pp viii + 688 (London Edward Arnold and Co, 1930) 12s 6d net

PROF DENHAM gives a lucid and logical exposition of his subject within a moderate compass He bases his arrangement upon the periodic system, and introduces new laws or generalisations as the occasions arise In this way he secures a continuity of narrative which is sometimes lacking in works dealing with this subject His method of presentation has the further merit of effecting a smooth correlation of the purely descriptive side of inorganic chemistry with some of the leading conceptions of physical chemistry Objection may be raised to certain details, such as the designation of phenol as an aromatic alcohol (p 377) and the statement (p 363) that "nearly three hundred hydrocarbons have been isolated" On the whole, however, the book appears to contain very few factual misstatements We suggest that more information respecting the localities in which important minerals are found might be included with advantage in a future edition Altogether, this is a carefully planned book, which may be recommended for the use of advanced classes in the schools and intermediate classes in the universities It is well printed, adequately illustrated, and easy to read

Growing Up How one did it in Different Times and Places By Ellen C Oakden and Mary Sturt Pp 238 (London Kegan Paul and Co, Ltd, 1930) 5s net

THIS book embodies an excellent idea, and the idea is very competently carried out It is meant for boys and girls, but we should not envy the adult who failed to find it interesting The book tells what sort of lives boys and girls lived, and especially how they were educated, in other times and in other lands—in ancient Greece, in the Middle Ages, and the age of chivalry, in Shakespeare's time, a century ago, and fifty years ago It tells how ladies were made in times gone by, and what sort of life a boy lived in the pioneer days of western America The fare is varied, but not incongruously so

One point strikes us forcibly Our forbears never learnt the elements of scientific method in school laboratories But some of them, as this book reminds us, managed to acquire a keen and a life long interest in the wonders of earth and sea and sky The old fashioned naturalist, who loved Nature, but set small store by analysing and dissecting her, knew something of the joy of living, which is less common since we began to teach science in our schools So perhaps even now we have not hit upon the very best way of 'growing up'

The Living Past By John C Merriam Pp xii + 144 + 16 plates (New York and London Charles Scribner's Sons, 1930) 7s 6d net

THE author of this little book has obviously pondered deeply on the facts revealed by geological science He tells us that the seven chapters are "episodes selected because of their touch with especially significant aspects of the problem of life history", and the subjects he has chosen are mainly drawn from the magnificent sections of the Grand Canyon of the Colorado On his themes the author has written lightly with singular grace and charm, and the absence of technical details will add to the pleasure of the general reader The book is well illustrated, but the price seems too high

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Crystal Structure of Krypton

WE have made two Debye-Scherrer exposures of solid krypton at the temperature of liquid hydrogen boiling under normal pressure, one with copper K_α radiation, the other one with unfiltered iron radiation. As was to be expected, we found a face-centred cubic lattice. The lattice constant is 5·59 A. The calculated density is 3·13. The distance of the centres of neighbouring krypton atoms amounts to 3·96 A., whereas from viscosity measurements the value 3·23 A. is deduced for the diameter of the atoms. Ratio 1·22; the analogous ratios for neon, argon, and xenon are 1·35, 1·29, and 1·23 respectively.

We are indebted to G. Claude for the quantity of krypton we used.

A more detailed account of this work is being published in the *Proceedings of the Amsterdam Academy*.

W. H. KEESOM.
H. H. MOOY.

Leyden, May 31.

IN a previous letter to NATURE upon the crystal structure of xenon, we announced that we would next examine krypton. We have modified the camera used for the previous experiments by reducing to a great extent its internal volume and making it perfectly gas-tight, so as to be able to work in a krypton atmosphere, thus overcoming the difficulties previously encountered.

The gas has been brought to the solid state upon a quartz capillary (set in the axis of the Debye camera) internally cooled by liquid nitrogen. The photograms obtained, with iron anticathode, showed 14 lines, 4 of which belong to the K_β radiation, corresponding to a face-centred cubic structure. The lattice constant of the elementary cell of krypton, containing 4 atoms, is $a = 5·78$ A. The following data have also been calculated: volume, 193×10^{-24} c.c.; density, 2·83 gm./c.c.; atomic radius, 2·04 A. Experimental details and a discussion upon the present data will be published elsewhere.

G. NATTA.
A. G. NASINI.

Departments of General and
Industrial Chemistry,
Royal Polytechnic, Milan,
May 31.

Ethyl Alcohol: a Product of High Pressure Syntheses

DURING a recent discussion at the Royal Society on catalytic reactions at high pressures, Mr. M. P. Applebey, of the Imperial Chemical Industries, Limited, Billingham, remarked that "in our experience we have never succeeded in obtaining with any catalyst whatsoever, more than a mere trace of ethyl alcohol".

This statement, which expresses a matter of fact, has since been followed by allusions in the Press which appear to suggest that there is some fundamental reason why this alcohol, unlike other primary alcohols, may not be produced in the series of condensations occurring between carbon monoxide and hydrogen in presence of various catalysts.

Dr. E. K. Rideal, writing in NATURE of April 12, p. 584, refers to the production through the foregoing condensations of a whole sequence of higher aldehydes and alcohols, "with the possible exception of ethyl alcohol."

A paraphrase of this statement appears in a leading article of *Chemistry and Industry*, April 25, 1930.

On the other hand, there is the testimony of Franz Fischer and Hans Tropsch ("Brennstoff-Chemie", **4**, 281; 1923), who found that in the presence of alkalised iron under pressure, ethyl alcohol was present among the condensation products of carbon monoxide and hydrogen. Moreover, in a lecture to the German Chemical Society (*Ber.*, **59**, 30; 1926), A. Mittasch included ethyl alcohol in a comprehensive list of the organic products of this condensation. It should, however, be recognised that these German memoirs indicate conditions such as favour the production of very complex mixtures, including alcohols, ketones, aldehydes, organic acids, esters, and hydrocarbons.

Working with various catalysts we have obtained evidence of the formation of ethyl alcohol in not inconsiderable quantities. Our specimens of alcohol boil at 78·2°/760 mm. and furnish ethyl 3 : 5-dinitrobenzoate melting at 92° and giving the same melting point when mixed with a 3 : 5-dinitrobenzoate prepared from an authentic specimen of ethyl alcohol.

It would accordingly be desirable to suspend judgment on this debated point until the appearance of more complete evidence. We propose to publish in the near future a detailed account of our production of ethyl alcohol from carbon monoxide and hydrogen.

G. T. MORGAN.
R. TAYLOR.

Chemical Research Laboratory,
Teddington, Middlesex,
May 24.

The Acquired Characters of *Alytes*

I AM glad that Prof. MacBride (NATURE, May 3) agrees that a reversion to the original environment would be likely to produce the result I suggest; but I am sorry he assumes that I accept Kammerer's work in the sense he does. What I said was, that even if all Kammerer's results with regard to *Alytes* were accepted, the experiment could not be held as complete until the effects of a reversion to the original environment had been demonstrated. Prof. MacBride now says that, unless there existed in the germ plasm potentialities to respond in a definite manner to changes in the environment, there would be no possibility of evolution.

I entirely fail to see any reason for this assertion. Such potentialities are doubtless of great value to the individual, but what is their relation to evolution? That such potentialities have been produced and may be modified in the course of evolution like other characters, most biologists would, I imagine, be prepared to admit; but it seems reasonable to regard them as the product rather than as the cause. Let me state a hypothetical case. An animal during its development passes through a stage where it possesses gills. It has the potentiality to respond to the environment so that if the parents are kept from water the gill stage occurs in the egg, but if the parents are given free access to water, the animal hatches out earlier and the gill stage occurs in the free swimming individual. I do not see, however often the change of environment may be made during consecutive generations, with its consequent temporary change in the character, that any new character or permanent

change in an existing character need be assumed For such a permanent change, a modification in the potentialities must occur

Prof MacBride apparently believes that such a modification is produced by the action of the environment upon the potentialities This explains his assertion that evolution would be impossible without potentialities in the germ plasm to respond in a definite manner to the action of the environment He is assuming the truth of *his* view of a disputed point The opposite view is that such modifications are produced in successive generations by the survival of those variations which occur in animals on the production of a new individual The case of Kammerer's *Alytes* does not seem to me to be convincing, even as stated by Prof MacBride

Since writing the above, I have seen Prof Przibram's letter in NATURE of June 7, p 856

Even if the statement be accepted that *Alytes* continues to lay its eggs in water after the temperature has been reduced, the original environment has not been restored, if it had, there would not be sufficient water for it to lay its eggs in A true 'return' to former conditions, then, necessitates the absence of water In saying that deprivation of water would not be such a 'return' but "induction in the opposite direction", Prof Przibram appears to me to be making an assumption necessary only if the facts are to be forced to fit in with a preconceived idea He has for the moment forgotten that von Nägeli's experiments have been carried a step further in the United States, and that the plants show various stages of modification in the characters they develop, corresponding to the variations in the environment Given the same modification of environment, the same modification of character appears, whether extreme or intermediate I see no more suggestion of the inheritance of acquirements in the case of *Alytes* than in the case of the plants

If Prof Przibram will extend his admission that the development of the nuptial pad depends upon 'external conditions' to the laying and hatching out of the eggs of *Alytes*, I cannot see why he should quarrel with any statement in my letter of April 12 As I said then, Kammerer's experiments with *Alytes* are not complete as they stand

CHARLES WALKER

The University,
Liverpool

An Exceptional Whirlwind in Natal

AT the village of Impendhle, Natal, on Mar 23, 1930, there occurred a whirlwind of considerable violence, and the damage resulting therefrom illustrates in a remarkable manner the great intensity of the rotatory and suctional forces that can be engendered The course travelled by the whirlwind could be followed, as a cloud was caught up in its vortex (Fig 1)

I am indebted to Mr E T A Minkner for the following notes and for the accompanying photographs

On the morning in question the wind came from the north, and during the whirlwind it changed to the west There was a little hail, but not much rain A peculiar, horizontal cloud was first noticed to the west of the village near the Impendhle Mountain The cloud moved in a northerly direction, and when above a certain hill known as the 'W' it became funnel shaped The funnel travelled in a circular course to the north and round to the east of the village Afterwards it became longer and thinner until it disappeared in the general canopy of cloud The photograph was taken at 1 45 P M, when the funnel-shaped cloud was almost in contact with the ground

The line of travel of the apex of the whirlwind over

FIG 1 —Cloud caught up by whirlwind Impendhle, Natal, 1 45 P M, Mar 23 (Photograph by Mr E T A Minkner)

the ground was marked by devastation The rotatory force rooted up grass and played havoc with a group

FIG 2 —Trunk of wattle tree twisted and shattered by whirlwind of Mar 23 at Impendhle, Natal. (Photograph by Mr. E T A Minkner)

of black wattle trees One tree about 3½ feet in circumference was bodily twisted off its roots and drawn up about 90 feet in the air, while another

larger tree had its solid trunk split and twisted in the manner shown in the second photograph (Fig 2)

The top of the tree and most of the lateral branches were broken off, and doubtless the leverage exercised by the action of the rotating wind on the boughs assisted materially in the twisting and shattering of the trunk, since it is almost inconceivable that the force exerted would be so excessive as to twist a tree trunk by direct action on the trunk itself

The great suctional force was demonstrated by the tree which was drawn up into the air It is clear that, if the whirlwind had happened to pass over a body of water containing fishes, a rain of fishes would have resulted In this connexion it may be mentioned that on April 14, 1909, an authentic case of the fall of fresh water fishes occurred at Newcastle, Natal

ERNEST WARREN

Natal Museum,
Pietermaritzburg

The Oogenesis of *Lumbricus*

THE current number of the *Quarterly Journal of Microscopical Science* contains an interesting paper by Dr Vishwa Nath on the vexed question of the oogenesis of the earthworm (*Pheretima*, in his case)

After having gone over the earthworm oogenesis again, we agree with practically everything Dr Nath has written However, we have found a 'vacuolar system' as well Dr Nath states that "Vital dyes, namely, neutral red and janus green *B*, have been extensively used [by him] in the form of very thin watery solutions, but they do not in any way improve the appearance of the egg " Dr Nath, Mr Harvey, and the senior writer have previously overlooked the 'vacuolar system', but if the ovary is left for *about an hour* in neutral red Ringer (pink solution) a fine system of red globules stains up We have no doubt that if Dr Nath tries longer periods he will also find these globules

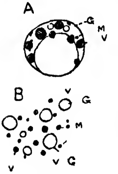

FIG 1

Now there can be no doubt that there is a real vacuolar system in mammals, molluscs, and insects, for in certain cases it can be seen without staining, or in directly fixed tissues (Kolatschew) But these globules in the germ cells of earthworms take a much longer time to stain (or appear) In cœlomic epithelial cells (Fig 1, A), however, they appear quickly, and certainly resemble the 'vacuome' of molluscs We could not satisfy ourselves that the globules were present in *Lumbricus* cells, *intra vitam*, without staining, or after osmic acid It does not seem possible entirely to dismiss the idea that these globules might be segregation vacuoles and not pre existing structures Possibly many neutral red staining globules are segregation vacuoles and have been confused with the neutral red vacuoles of such animals as *Abraxas* and *Cavia*, where there is, before staining, a definite pre-existing aggregation of globules We have also succeeded in staining a 'vacuome' in nerve cells of *Lumbricus*

One point we should like to stress These vacuoles filled with neutral red dye are not related in any way to the argentophile and osmiophile bodies, which can be seen *intra vitam* in the earthworm ovary and nerve cord, and are known as Golgi elements The mitochondria, the neutral red globules, and the Golgi elements can be seen side by side separately (Fig 1, B)

MAUREEN O'BRIEN
J BRONTË GATENBY

Trinity College, Dublin,
May 15

Fechner's Law

THE power of the eye to distinguish differences in brightness has hitherto been specified by the ratio $\Delta I/I$, where ΔI is the least perceptible increment in brightness when the eye is observing a surface of brightness I Weber stated that the ratio was constant, and this statement has been known as Weber's law or Fechner's law It was obvious to Fechner that the law did not hold for high and low intensities But he considered that these deviations were due to disturbing factors dazzle at high intensities, and the intrinsic light of the eye at low intensities

In a recent paper (*Phil Mag*, 8, p 520, 1929) R A Houstoun suggested that the reciprocal of Weber's ratio was a Gaussian probability curve when

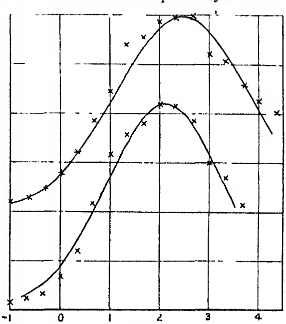

FIG 1

plotted as a function of the logarithm of the intensity We have tested this point, and a full description of the experiments will be published in due course, but we think it desirable to state here, in view of the number of physiologists and psychologists interested in the matter, that $I/\Delta I$ forms a good probability curve The accompanying diagram (Fig 1) shows typical sets of observations for red light, the abscissæ giving logarithms of the intensity and the ordinates $I/\Delta I$ In the interests of clearness, the zero of the one curve has been displaced vertically upwards The curves are probability curves fitted to the results The observations for blue light agree with those for red except at low intensities, where there is a deviation if the eye is dark adapted

It may be shown that the sensation at any intensity is proportional to the area to the left of that intensity, and that the obvious interpretation of the observations

is that we are dealing with a group of percipient elements, forming a homogeneous population, which come over the threshold as the intensity is raised

R. A. HOUSTOUN.
JAMES F. SHEARER.

University, Glasgow,
May 10.

Presence of a Yeast in the Death Watch Beetle (*Xestobium rufo-villosum* De G.).

IN a letter on the above subject in NATURE of April 26, p. 635, Mr. L. N. Staniland directs attention to the presence of yeast symbionts in *Xestobium* in connexion with the work of our colleague, Mr. W. G. Campbell, on the chemical aspects of the destruction of oak wood by powder post and death watch beetles, *Lyctus* spp. and *Xestobium* sp. (*Biochem. Jour.*, 23, No. 6, pp. 1290-1293; 1929).

A study of symbiosis in relation to certain wood boring beetles has been started by this laboratory in order to check and add to the results of the earlier workers Karawiew, Escherich and Buchner, and of the more recent investigators, Heitz and Breitsprecher. The work of the last named (*Zeitschr. f. Morphol. u. Ökol. der Tiere*, 2, parts 3 and 4, pp. 495 *et seq.*; 1928) is the most important in connexion with the Anobiidæ, with which family we are chiefly concerned.

So far, most of Breitsprecher's observations on the larvæ of *Xestobium* and *Anobium* have been confirmed. This worker could find no evidence of the presence of yeast organs in the ovipositor of dry museum specimens of *Ptilinus pectinicornis* L., but our sections of the larvæ have disclosed the presence of a pair of yeast filled organs lying anterior to the mesenteron and connected with it by means of very fine ducts. The larva of this beetle seems therefore to be more specialised in its symbiotic adaptations than that of *Anobium punctatum* De G., which in the opinion of Breitsprecher is the most highly developed in this respect of the Anobiids which he has examined.

We have succeeded in isolating pure cultures of yeasts from *Anobium* and *Xestobium*, but whether these yeasts correspond to the actual symbionts remains to be proved. It is hoped that some light may be thrown on the chemical aspect of the metabolism of these insects if the yeasts can be grown on cellulose media.

A histological study of the adult beetles has just been started. Meanwhile, our dissections of *Xestobium* females in conjunction with Breitsprecher's section work lead us to disagree with Mr. Staniland's use of the term 'spermathecae'. The organs to which he refers are, in our opinion, specially developed structures; the spermatheca with its associated gland is quite distinct and occupies a normal position for most Coleoptera, that is, just anterior to the bursa copulatrix.

RONALD C. FISHER.
E. A. PARKIN.

Entomology Section,
Forest Products Research Laboratory,
Princes Risborough, Bucks,
May 9.

Raman Effect in Metallic Halides.

IT is known that the crystalline halides of the alkali metals (for example, rock salt) fail to exhibit the Raman effect. With the view of elucidating the reason for this behaviour, I was led to examine a series of other crystalline metallic halides, using the technique described in a recent note (NATURE, Mar. 22, p. 463). Amongst the numerous solids examined, the two chlorides of mercury stand out conspicuously, giving Raman lines of great intensity corresponding to both positive and negative shifts of frequency (Figs. 1 (*a*) and (*b*), lines marked with arrow, the exciting line being 4358 A.).

When we compare the highly contrasted behaviours of the chlorides of mercury and of the alkaline halides, and remark that mercurous chloride is insoluble in water, and that mercuric chloride in solution is a poor conductor of electricity, the inference is suggested that the electrovalent type of chemical union between atoms is unfavourable, while on the other hand the covalent type of linkage is highly favourable, for the production of the Raman effect. This

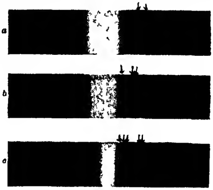

FIG. 1.—Raman spectra of (*a*) mercuric chloride (*b*) mercurous chloride and (*c*) sulphur.

inference is supported by all the evidence obtained by me. It is found that lithium, barium, and thorium chlorides give no observable effect. On the other hand, the solid trichlorides of antimony and bismuth give strong Raman lines, while auric chloride, cadmium iodide, and anhydrous zinc chloride give just detectable lines of feeble intensity. The contrasted behaviour of stannous and stannic chlorides is also an example worthy of special mention. The former gives no new lines, while the latter is a liquid which gives an extremely strong Raman spectrum.

Fig. 1 (*c*) is the Raman spectrum of ordinary rhombic sulphur with the green line of the mercury arc as the exciting radiation. It is of interest as showing that the Raman effect may be successfully photographed even with strongly coloured solids.

P. KRISHNAMURTI.

210 Bowbazar Street,
Calcutta, India.

Raman Effect of Sulphuric Acid.

USING incident mercury light, the Raman effect of sulphuric acid at varying concentrations has been studied. In the results below, 100 per cent is the purest acid obtainable; 50 per cent is 1 molecule of sulphuric acid to 1 molecule of water; 0 per cent is pure water.

At 100 per cent, Raman lines were obtained at 4585 A., 4566, 4542, 4470, 4438, 4276, 4252, 4224, 4203, 4171, 4142. These decreased in number and intensity at 90, 80, 70, and 60 per cent, until at 50 per cent the lines found were 4566 A., 4542, 4470, 4438, 4224, 4203. At 40 per cent, Raman lines were found at 4566 A., 4547, 4474, 4441, 4224, 4203. At 30 per cent no lines were found, but weak bands were present, which were probably due to the water, for they increased in number and intensity at 20, 10, and 0 per cent.

Forty-five per cent concentration gave the same results as 50, and 35 the same as 30. The sudden change between 45 per cent and 35 may indicate that

a large number of molecules are broken up into ions between those points Some of the lines found at 40 per cent may be due to sulphate ions. Most of the lines in pure sulphuric acid were easily obtained in a three minute exposure and the strongest appeared in a one minute exposure For other concentrations fifteen minutes was sufficient

RAYMOND M BELL
W R FREDRICKSON
Syracuse University,
Syracuse, New York, May 9

The Swimming of Cuttlefish

IT may not perhaps be generally realised that the common cuttlefish, *Sepia officinalis*, uses its siphon for slow swimming in all directions, as well as for the more violent backward leaps We recently had an opportunity of watching the behaviour of cuttlefish which were swimming at eye level and above our heads in one of the large tanks of the Plymouth aquarium We were rather surprised to notice that while moving slowly forwards with its fins undulating, the cuttlefish had its siphon curved back ventrally and was assisting its forward motion by emitting gentle squirts of water (Fig 1, A)

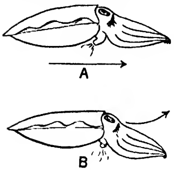

FIG 1

If the cuttle wished to turn to one side it would point its siphon opening to the opposite side and squirt a little more violently (Fig 1, B) In fact, for all its general slow movements the siphon appeared to be used, the undulations of the fins merely keeping the motion continuous and preserving the balance In the quick backwards swimming the fins were depressed along the side The siphon was extended about an inch and a half and could be pointed in any direction

F S RUSSELL
G A STEVEN
Marine Biological Association, Plymouth

Echo Sounding and Depths

IT is to be feared that the note on page 473 of NATURE of Mar 22 may lead to some misunderstanding and to conclusions unfavourable to the echo method of sounding Dr Maurer states that out of 254 comparative soundings made by wire and echo in water over 2000 metres deep no less than 36 showed differences exceeding 100 metres and that the maximum difference was 650 metres It should not be overlooked that a part, possibly a large part, of the error may be due to the curvature of the wire when the ship was drifting, for it is known that as a rule the depth by echo is less than that by wire even when the bottom is regular Dr Maurer also considers that the crude echo distance, calculated on a constant velocity, is more useful to the seaman for fixing his position

It scarcely seems probable that deep soundings would ever be used for fixing a ship's position, except possibly cable or surveying ships, so that to the ordinary navigator the difference between corrected and uncorrected soundings would be of no importance

In coastal water where the depth, or better, the rate of change of depth, gives valuable information in thick weather, the correction is of small practical importance when expressed in fathoms or metres except in some places such as the Red Sea Special warnings are inserted on the Admiralty charts in such cases

The Supplementary Hydrographic Conference, which was held at Monaco in 1929, resolved that all soundings should be corrected so far as possible before being placed on the charts, and did not adopt a standard velocity of sound in sea water

H P DOUGLAS
(Rear Admiral and Hydrographer of the Navy)
Hydrographic Department,
Admiralty, London, S W 1, May 3

The Ions Produced by Discharges at Liquid Surfaces

WE regret that, in our paper (*Proc Roy Irish Acad*, 39, A p 21) in quoting Prof Zeleny's description of the discharge from an alcohol point in the form of a stream of minute drops, we did not make it clear that this description applied only to discharge under the conditions of instability indicated in his letter in NATURE of May 10 We are in agreement with Prof Zeleny that the discharge from a stable liquid surface is similar to that from a metal point, we find that it is carried by ions of the ordinary kind But although we have observed the conditions of surface instability and the transport of liquid mentioned by him, we have been unable, under the conditions of our experiments, using water and a number of alcohols, to find any evidence by Chattock's method of the big drag on the gas which discharge currents carried altogether by drops should produce We find evidence only of ions, which for a life of about 1/5000 sec have mobilities similar to those of ions produced in air by the ionising radiations

On the other hand in recent work, we have observed that in air drawn away from a discharging water point, there are present large ions having mobilities at least as low as those of the large ions of Langevin

J J NOLAN
J G O'KEEFFE
University College, Dublin,
May 16

Slug or Horned Viper?

As my name was mentioned by Prof T D A Cockerell in his letter in NATURE of May 17 on the identification of a certain animal represented among the incised carvings at Karnak, may I point out that the figure in question is the Egyptian hieroglyph for the letter F? I am informed by my colleague, Mr A Shorter, of the Department of Egyptian and Assyrian Antiquities, British Museum, that the animal portrayed in that symbol was identified as a slug so long ago as last century, the identification being based on a representation published by Prisse (1847), but that it has been more commonly recognised as the horned viper (*Cerastes cornutus* (Linn)) The 'horns' in the figure, if somewhat exaggerated, are like those of the viper and do not resemble the tentacles of a *Veronicella* (the slug which has been suggested), in which there are in fact two pairs of these appendages The clearly defined head and slender 'neck' which are shown in the Karnak figure are not found in *Veronicella*

G C ROBSON
Zoological Department,
British Museum (Natural History),
Cromwell Road, London, S W 7,
June 3

Physics in Relation to Wireless *

By Dr W H ECCLES, F R S

THE preparatory research work for the transmitting station, that is, for generating electromagnetic waves, was done by Hertz in the years 1885–88, and appears to have been prompted by the rivalry between the extant theories of electricity and magnetism The laboratory work for the receiving station was done by Lodge in 1889, by Minchin and by Branly in 1890 Lodge's work on the reception of electric waves arose from observing that two metal knobs nearly in contact cohered when a spark occurred near them , Minchin's work was on light sensitive cells and his observations of the effects of electric waves was a side issue, but was duly recorded , Branly's investigations were on the diminution of the electrical resistance of contacts between oxidised metals and in masses of filings when sparks were made near by

Without asking which physicist we are to thank for each of the items needed for making a complete sending and receiving equipment for wireless telegraphy, we know that Oliver Lodge demonstrated the transmission of signals across a space of 30 yards and through several walls at the Royal Institution, London, on June 1, 1894 On this occasion a filings coherer was used, and the necessity of screening various portions of the receiver and its leads, which later became part of early wireless engineering, was emphasised Later in 1894, during the summer meeting of the British Association at Oxford, Lodge demonstrated the sending and recording of Morse code signals He used a Hertzian oscillator with large copper plates as capacity areas, an induction coil with the usual vibrating interrupter and a Morse telegraphic key in the primary of the coil As receiver he used a filings coherer with attached aerial wires for picking up the waves, a trembler of electric bell type operated by the coherer current and serving to shake the filings back to their non conductive condition, and a Morse inker for recording the dots and dashes on tape Other telegraphic instruments were employed as alternatives The following year Popoff, a Russian physicist, added to the recording apparatus a long earthed vertical antenna for catching natural electric waves produced by distant lightning discharges , he had possibly adopted the vertical wire from the patents of Dolbear and other American inventors

By 1895, therefore, every item was ready for the attention of the engineer , some parts of Lodge's apparatus had to be made more powerful, other parts more sensitive, and all of it more trustworthy and robust before it could be put into the hands of telegraphists for everyday use Improvements came rapidly, and the range of action was gradually increased, but progress was limited by the use of highly damped trains of waves At this date the spark gap at the sending station was situated in a long vertical wire, possibly surmounted by a large metal plate, and the coherer was in another similar antenna at the receiving station Such an arrangement had a high decrement and therefore *any* transmitting station affected *every* receiving station within range, and only one pair could work at a time

In Europe, so far as printed records can tell us, the earliest use of ' tuning ' coils in open oscillating circuits was due to Lodge, who appears to have satisfied himself by laboratory experiments in 1896 and 1897 not only that inductance coils were useful in a Hertzian oscillator for adjusting frequency, but also that their employment brought certain advantages over the method of adding capacity areas The main advantage of inductance over capacity in an open oscillator is that the former prolongs, the latter shortens, a strain of oscillations produced by a spark In consequence, if straight Hertzian oscillators be used as sending antenna and receiving antenna, and they be tuned to each other by inductance coils, the damping of each is made low and sharp resonance may be attained

Lodge's patent in 1897 embodying this principle produced a revolution in both thought and practice Hitherto it had been imagined that the electrical oscillations produced by the spark gap in the aerial possessed a very short wave length of the same order as the dimensions of the spark balls, just as in the case of the Righi oscillator , and the function of the transmitting antenna had been explained by supposing that the Righi waves ran up the wire and squirted out at the top This seemed to explain why high wires were needed for long ranges But now it was seen that the high wire vibrated as a Hertzian oscillator with a wave length of the same order of magnitude as the length of antenna, and that range of signalling was related to length of wave Moreover, Lodge's patent specification disclosed a scheme for exciting a metallically continuous antenna from a spark in a branch circuit, thus contradicting the accepted idea that radiation was impossible unless the spark was formed in the antenna Stranger still, the receiving antenna was shown as a continuous straight oscillator with its tuning coil acting as the primary of a high frequency transformer, the coherer being connected into the secondary circuit Being, in fact, a mine of scientific information and suggestion, Lodge's specification furnished during several succeeding years all the fundamental ideas employed by the engineers who developed commercial signalling plant of the spark type

In illustration of the last statement and to put on record another triumph of the laboratory, I may cite the important development known as the quenched spark transmitter The germ of this appears in Lodge's patent, where it is explained that an antenna would become a more persistent oscillator if it were excited by a short-lived spark in a side circuit The cessation of the spark automatically frees the antenna from the branch circuit

* From the presidential address to the Institute of Physics entitled The Influence of Physical Research on the Development of Wire, delivered on May 27

and from the dissipation of energy in it The idea was improved upon by Max Wein in 1906, who, for the purpose of his laboratory measurements, invented a form of gap that ensured rapid quenching This was developed by the Telefunken engineers into a type of transmitter that has seen world-wide service

From the year 1900 onwards the more alert workers in wireless sought about for a method of generating continuous waves The hope of achieving wireless telephony was the incentive, for no one at that time foresaw that continuous wave telegraphy by the Morse code could be better than spark telegraphy The problem was to devise a method of generating continuous waves of frequency at least 100,000 cycles per second The physicists' solution came from an unexpected direction, namely, from the scientific investigation of the properties of an electric arc traversed by alternating currents of low frequency In 1900, Duddell was pursuing these investigations on carbon arcs and happened to connect across the arc gap an inductance coil and condenser in series just as if the arc gap was a spark gap He was surprised to find that the arc whistled when ignited, and soon discovered that the pitch of the note depended on the magnitudes of inductance and capacity of the shunt circuit in the same way as in a spark circuit

The study of the oscillating arc was taken up by Poulsen in Denmark and he investigated the Duddell phenomenon when the arc burnt in various gases and between various electrodes By 1903 he discovered that an arc burning in hydrogenous vapour between a copper anode and a carbon cathode was capable of developing currents of frequency required for radio-telephony and of considerable power This splendid discovery led straight to practical radiotelephony

Fessenden invented the heterodyne method of receiving telegraphic signals The method relies upon the employment of a local source of electrical oscillations near enough in frequency to that of the incoming wave to produce in the receiving circuits regular increases and decreases of amplitude at an acoustic frequency The conception comes straight from the storehouse of acoustic theory, and could only have arisen in the mind of a student and teacher of physics, like Fessenden It is, in my opinion, one of the four or five universally important steps in the history of wireless technique

The most striking example of the discontinuity of the progress of wireless is afforded by the maturing of the amplifying vacuum valve

The first vacuum tube containing a hot filament and a separate electrode with external lead, that is, the first thermionic diode, was made by Edison in 1883 Studies of the thermionic current across the vacuum were conducted by Hittorf (1883), Preece (1884), Elster and Geitel (1887), and Fleming (1889 and 1896) Three years later J J Thomson's laboratory took up the problem and, in particular, O W Richardson during the next three years pursued his classical researches, usually employing a form of diode that has become typical, namely, a straight filament along the axis of a cylindrical anode Meanwhile an analogous form of diode in which the source of electrons is a photo electric surface was being similarly studied Many of the researches of the date were aimed at measuring the charge and the mass of the particles carrying the current across the vacuous space, and for this purpose other electrodes were sometimes introduced for deflecting the particles by an electric field Lenard, in 1902, used an anode of wire gauze so that light could pass through it to the cathode and liberate electrons, Wulf later used a flat spiral of wire, parallel to the photoelectric cathode for the same reason, Varley in 1903 observed that when the gas pressure was below about five microns the electrons could be accelerated towards a positive grid so as to be shot through the meshes of the gauze At higher pressures ionisation by collision occurred near the grid and gave such tubes their steep characteristic curves Besides all this experimental work of an abstract nature, various applications of the electric discharge through gases had been made to the rectifying of alternating currents Thus the scientific atmosphere of the first three years of the twentieth century was thick with material ready for useful applications

The first application of vacuum tube physics which I have to notice was made by the well known German physicist Wehnelt, who, having discovered in 1903 that filaments coated with oxides of rare earths emitted electrons copiously, patented a diode with coated filament as a rectifier in January 1904 He called this thermionic diode an electric valve It is sometimes said that Wehnelt invented the thermionic valve—but this is a fallacy, he invented the coated filament, and he invented the name, perhaps, but thermionic tubes with two electrodes had long been commonplaces in physical laboratories It is noteworthy that, apart from the valuable invention of the oxide coating, Wehnelt's application is widely used to day at many transmitting stations for rectifying alternating current and in the so called 'battery eliminators' of broadcasting sets About eleven months after Wehnelt, Fleming patented the combination of a thermionic diode, a coil and an indicating instrument, to form a circuit in which alternating current could be produced and rectified, special stress being laid on the applicability of the circuit for detecting by rectification the feeble alternating currents experienced in wireless receivers The diode as detector was in the field for several years as a rival to the electrolytic and contact detector The third interesting application of vacuum tube physics was made a year later by von Lieben, who proposed to utilise the lateral deflection of a stream of electrons as an amplifier The current to be amplified was intended to cause the deflection—either by charging an auxiliary electrode which then attracted or repelled the stream, or by producing a magnetic field The fourth application was made a year later in America by de Forest, who, by means of an auxiliary electrode in the form of a grid, controlled the passage of the electrons to an anode by accelerating or decelerating them in their line of motion

This method of control proved, in the course of a few years' development, more effective for amplifying purposes than the method of control by lateral deflection

The introduction of the von Lieben and the de Forest tubes is specially notable because these instruments were not alternatives to existing ones but were novel in purpose as well as in principle Von Lieben at any rate—de Forest seemed to be rather vague—clearly appreciated that an inertialess magnifying device was in his hands—the first distortionless repeater in history Unfortunately, neither form of instrument became an immediate practical success, perhaps because evacuation was not pushed far enough Von Baeyer was probably nearer success than either, for independently of de Forest, in 1907 he constructed a triode of ideal modern form containing a cylindrical anode two centimetres in diameter, a coaxial gauze cylinder one centimetre in diameter, and a filament in the common axis of the cylinders, and more highly evacuated than de Forest's tubes appear to have been But von Baeyer was engaged on the study of the motion of the electrons from the incandescent filament, and never applied the excellent amplifying functions which it undoubtedly possessed

The key to the situation was really lying all the time in Varley's remark in his 1903 paper, that electrons did not pass through the grid in quantity until the vacuum was below five microns However, during these years the physical laboratories intent upon the study of electricity at extreme exhaustions developed several methods of producing and retaining very high vacua In the years 1912 and 1913, Langmuir, working in the laboratory which also evolved the Coolidge X ray tube, gave the triode a more stable behaviour by resorting to extreme rarefaction

The technical value of the high vacuum triode rests upon its ability to magnify very small and very rapid electrical changes with close fidelity An electromotive force applied to the grid causes inappreciable current flow but liberates a magnified electromotive force in the anode circuit where relatively large currents are possible The development in size of triodic oscillation generators made them feasible for the transmission of signals, while small sizes improved reception—a remarkably happy concatenation

After this last revolution in wireless technique, later developments in the apparatus and methods of radio communication seem relatively undramatic For my present purpose I need only give one or two examples, with which I am very familiar, of the influence of the physical laboratory There are two methods of generating electrical oscillations for transmitting stations which have appeared as alternatives to the back coupled valve method, and have been adopted in large short wave stations all over the world The first is the crossed valve method, which was devised in the physical research laboratories of Finsbury Technical College in 1916–17 at the request of the Signal Experimental Establishment of our War Office It was intended for use over short distances behind the trenches on wave lengths of 50 metres and less

The second method aims at generating electrical oscillations of very constant frequency by aid of massive bodies sustained in mechanical vibration by triodes The earlier apparatus for this purpose was the tuning fork alternator, which was developed in 1918 for delivering fundamental and harmonic frequencies for the purposes of measurement in the physical laboratory A later apparatus arose out of the growth of supersonic under-water signalling in 1917 In the autumn of that year Langevin in France and Rutherford in England independently suggested that the piezoelectric qualities of quartz might be utilised for perceiving the arrival at a receiving station of pressure waves in water and for producing such waves at a transmitting station Langevin's work at Toulon was supplemented by his collaborators at Finsbury Technical College and Harwich, and at Finsbury this led, first, to an appreciation of the fact that quartz vibrating under the stimulus of a feedback circuit steadied the electrical oscillator, and, later, to a triode circuit for automatically sustaining quartz in vibration at its natural frequency in water without the use of back coupling At about the same time, we learned later, Nicholson in the New York laboratory of the Western Electric Company, devised an equivalent method of vibrating piezoelectric crystals such as Rochelle salt in air by aid of a triode Thus came about what may be called the marriage of mechanical and electrical oscillations, the so called 'stabilisation of frequency', which plays so large a part to day in wireless stations, large and small

My account of the contributions of physicists to wireless omits all reference to the great engineers who have adorned the industry, as otherwise this address would become a complete history of wireless, but I must refer to the effect upon practical wireless of the study of the electrical properties of our atmosphere—a branch of geophysics—which has already assisted practical operation of telegraphic circuits In Great Britain the study has been pursued under the auspices of the Radio Research Board and independently by T L Eckersley In my opinion the cumulative effects on radio communications of these researches will disclose itself in the near future

A valuable geophysical discovery made neither by physicists nor engineers was the phenomenon that short waves could travel long distances Short wave transmitting and receiving apparatus was much used during the War, for example, 50 metres for trench sets and less than 20 metres for aeroplanes, in several of the belligerent countries, short waves had been tried for telephony across a hundred miles of the North Sea and between London and Birmingham overland, but were not suspected of shooting aloft and coming down thousands of miles away We now know that trials made within the skip distance were inevitably misleading However, before 1920 all the technique of short wave telegraphy and telephony was complete As a mere chance, amateur wireless enthusiasts were officially relegated in most countries

to transmission experiments on waves shorter than 300 metres Gradually widely scattered amateurs began to overhear signals exchanged between two very distant colleagues In 1921, American amateurs transmitted to British amateurs on wave lengths of 200 metres, this was reciprocated in 1922 Meanwhile the American amateurs had found shorter waves better, and in 1923 were communicating easily with other amateurs across world-wide ranges The first commercial application was made in the autumn of 1923 and has been followed by universal adoption of short-wave signalling It is a remarkable example of a revolution in method which was not due to, and did not require, any change of technique—a revolution effected by pure discovery

The Concept of Space

ON Friday, June 6, Nottingham was honoured by a visit from Prof A Einstein, who delivered a lecture (in German) in the Great Hall of the University College After each section an English translation was given by Dr H L Brose The chair was taken by Prof H H Turner The lecture was an account of the history of the concept of space, and was addressed to a general audience At the end questions were invited those received were all concerned with the present position of the unitary field theory For the following impression of the lecture I am deeply indebted to Miss Dallas and Miss Lieber for their help, but for any inaccuracies I alone am responsible

At the outset Prof Einstein emphasised that he was not making an authoritative pronouncement, but merely stating his own personal opinions He believed that the fundamental concept of physics was that of the rigid body The idea of space was not acquired until a much later date, and was not known to the ancient Greeks Euclid's geometry, in particular the part dealing with the congruence of triangles, was based upon notions of rigid bodies, such as measuring rods which could be moved about as a standard of comparison Motion appeared first, not as in space, but as that of one body relative to another The concept of space was introduced by Descartes, the founder of co ordinate geometry This was a purely mathematical notion, without any physical implications, and concerned only with the geometrical aspect of the relative position of two or more bodies The other aspect of space was due to Newton, who considered the bodies, not at rest, but in motion To deal with the problem of acceleration he introduced the idea of an absolute space, forming a framework by which the motion of the bodies could be measured, but itself quite unaffected by those bodies It was a wonderful thing that Newton's genius enabled him to realise the definitely physical reality of space This reality has been neglected or misunderstood by many of his successors, including the philosopher Kant

However, in Prof Einstein's opinion, the really decisive change from the geometrical to the physical conception of space was due to Faraday and Maxwell, who considered electromagnetic phenomena to have their seat in the ether, and spoke of the field or the state of this ether as affected by electro magnetic action Why did they think it necessary to use a new word ether, when the old one space was already available ? The reason, no doubt, was that they were fettered by the ideas prevailing in their day, and had not realised the connexion between the space of geometry and the space of physics As material bodies were the first objects to be considered in physics, they introduced the idea of a material ether to replace what was formerly considered as empty space, through which electro magnetic action took place This idea was developed by Lorentz, in whose view all electromagnetic action, even that in the interior of material bodies, really took place in the ether Thus he deprived matter of all its electromagnetic properties, but to compensate for this he deprived ether of all its mechanical properties, and attributed a capacity for motion only to the elementary particles of matter

The next modification was the special theory of relativity Classical physics used three co ordinates in space and one in time It was now found necessary to unite these into the four co ordinates of space time, and to give up the belief that events could be divided into categories of 'before', 'simultaneous', and 'after' This prepared the way for the general theory of relativity, which dealt with the phenomena of inertia and derived the laws of motion from the geometrical structure of space, or rather of space time, thus uniting geometry and physics in a new intimacy The experimental verification of this theory is well known We have now come to the conclusion that space is the primary thing and matter only secondary, we may say that space, in revenge for its former inferior position, is now eating up matter

With regard to the unitary field theory, the purpose of which was to derive all physical phenomena, electromagnetic as well as gravitation, from the properties of space, Prof Einstein confessed that his colleagues did not agree with him In fact, he added with a smile, they think that I am crazy on this subject However, he himself had faith that the idea (which came to him during a severe illness two years ago) of attributing direction as well as metrical structure to space would ultimately lead to success in obtaining a single theory to embrace all phenomena He regarded this as a true physical theory, not as a mere mathematical curiosity It was best to leave aside the difficulties of the quantum theory for the present, but he hoped that when the simpler problem of

matter in bulk was solved the more difficult ones relating to atomic physics could speedily be dealt with The urgent thing at present was to obtain the equations of motion of an electron or proton Although the theory was not yet finished, he firmly believed that the end was very near

Amid enthusiastic cheers, Alderman Huntsman, chairman of the College Council, announced that the blackboard used by Prof Einstein and signed by him would be varnished and preserved in memory of a historic occasion

H T H PIAGGIO

Obituary

PROF K J P ORTON, FRS

HIS friends even now find it more than a little difficult to realise that they have looked their last on Kennedy Orton—his vigour and freshness of mind and body, his keenness in attack on any problem, scientific or administrative, had suffered so little diminution with the passing of the years, that those who knew him well looked forward with no thought of the end to that stimulating interchange of ideas, to those talks ranging from China to Peru, which now are fated to remain but cherished memories

Orton was a born man of science Intended for a medical career, he found that the microscopical work involved was likely to prove too severe a tax on his eyesight, and he turned to the study of pure chemistry As a scholar of John's he worked at Cambridge from 1891 to 1895 under Liveing, afterwards proceeding to Heidelberg, where he took his doctor's degree *summa cum laude* Victor Meyer's attractive personality left a deep mark on Orton's character, and one is tempted to speculate on the rapidity of thought, the energy and versatility, the power to pick out underlying resemblances from surface differences, the single hearted devotion to the pursuit of knowledge for its own sake, which were common characteristics in the mentalities of master and scholar

He returned to London master of a wide range of chemical philosophy, and already interested in the properties of and mechanism of substitution in halogen compounds of benzene derivatives, well versed in laboratory technique, a skilled worker in glass In truth, he always retained keen interest in carefully planned and neatly executed laboratory work, and if ever he showed appreciation of his own powers it was when, with justifiable pride, he recalled instances of the evolution of skilful and enthusiastic researchers from distinctly unpromising material

For six years he worked as demonstrator in chemistry at St Bartholomew's Hospital, and in 1903 he was appointed to succeed Dr J J Dobbie in the chair of chemistry in the University College of North Wales The deep and accurate knowledge, the administrative ability, the sympathy for, and understanding of the student mind that he brought to his task at Bangor are well known to those whose good fortune it was to serve with him or to be taught by him, and his election to the Royal Society in 1921 testified equally to the value of his own researches and to the influence of the school of chemistry which he directed

Orton's output of research was large—the general index of the *Journal of the Chemical Society* marks sixty-two titles under his name between 1897 and 1922 Looking over these and his later papers, one is struck by the clearness of their outlook—there is a refreshing absence of ragged edges, of untidiness or diffuseness of thought, diction, or method The problem is clearly stated, attacked by well planned experiments, and the result, positive, negative, or doubtful, is set out in vigorous language free from the slightest trace of ambiguity

Substitution in aromatic compounds, and the problems involved in the theory of the intramolecular migration of atoms had early occupied his attention, and during his time in London he had, in conjunction with Chattaway, attacked such problems as the substituted nitrogen chlorides and their rôle in the halogenation of anilides and anilines About this period, too, his work on the action of light on nitrogen iodide shows his interest—an interest which never left him—in the efficacy of light in promoting chemical change

A remarkable research, carried out at Bangor, showed that the migration of halogen in substituted acyl anilides is dependent on the intermediate liberation of chlorine,

$$C_6H_5N\,Cl\,Ac + HCl \rightleftarrows C_6H_5NHAc + Cl_2 \\ \longrightarrow C_6H_4Cl\,NHAc + HCl$$

This work threw great light on the mechanism of the reaction, and confirmed Armstrong's general view that hydrochloric acid is the catalyst Orton turned again and again to the consequences of this work, developing therefrom a method for the regulated chlorination of aromatic substances, and for the production of an acetic acid solution of known chlorine concentration

In collaboration with his students he carried out much valuable work, involving studies of the mechanism of acetylation and of halogenation, on acetic acid and acetic anhydride He consistently applied physico-chemical methods to the elucidation of the mechanism of organic reaction, and in some of his later work turned to the more purely physical side of his science, as is shown by his development with D C Jones of the technique of work on the mutual miscibility of liquids and of the determination of critical solution temperatures of ternary mixtures as a criterion of purity

Orton was, however, much more than a chemist, and any survey of his activities limited to the chemical side of his life's work would present but a warped view of his character His busy life left him but scant leisure, and the greater part of such spare time as he could command was devoted to

rock-climbing and to the study of the habits and movements of birds In this last-named region he was an acknowledged authority, and though his chapter on "Bird Life in the Mountains" in Carr and Lister's "Snowdonia" gives some adumbration of his powers, it is a matter for regret that he has not left more detailed records of his bird lore

Withal he had a critical knowledge of much that is best in our national literature, and, realising his reticence in certain directions, his intimates discovered with keen pleasure that a treasured volume of Arnold's poems was a constant companion in his wanderings over the Sussex downs

Orton's view of the function of a university was no narrow one, and he saw, more clearly than many men of science, the danger of losing the cultural value of a university training that comes from laying over emphasis on the specialist's work and on that technological side of a student's labours which is concerned with preparation for living rather than for life His interest in his students was unflagging and their graduation did not set a period to that interest On more than one occasion has an old pupil found the helping hand out stretched even before he had thought of turning to his teacher, and, veteran or recruit, no one could go to Orton for advice or help without feeling that he was giving of his best

Truly his days were in every sense full ones, and if in rare moments depression seized him, it was because he, more than most, realised what deep significance Νὺξ γὰρ ἔρχεται bears

> For at my back I always hear
> Time's wingéd chariot hurrying near
> And yonder, all before me, lie
> Deserts of vast eternity

It is small wonder that, urged by his ever present sense of the fleeting of time, he so grievously over taxed his natural powers that pneumonia found him with no reserve of strength to resist its advances, so that after a few days' illness he died peacefully on Mar 16

He rests in a wind swept Anglesey churchyard, with the waters of the Menai lapping at his feet, and the mountains he knew so well heaving aloft their vast masses on the sky line Deeply as we mourn the cutting-short of a life in the plenitude of its powers, regret is assuaged by the thought that Orton had crowded into his fifty-seven years a record of work well worthy of one privileged to live beyond three-score years and ten

ALLAN FERGUSON

MR A S HIRST

MR ARTHUR STANLEY HIRST, whose death at sea on May 4 was reported from Colombo, was formerly an assistant keeper in the British Museum (Natural History) He was born in 1883, and was the son of the late Dr Albert Hirst, of Hackney He was educated at Merchant Taylors' School and studied zoology under the late Prof Minchin at University College, London

On entering the service of the British Museum, Hirst worked for some time in the mammal room, but was afterwards placed by Sir Ray Lankester in charge of the collections of Arachnida and Myriopoda He studied various sections of these extensive groups and published a long series of systematic papers on them, but latterly he gave his attention almost exclusively to the Acari or mites, the economic importance of which has led in recent years to a great increase in the number both of specimens and of inquiries reaching the Museum Hirst's papers on the Acari were marked by great accuracy of description and laborious investigation of detail Many of them contain facts and suggestions which will one day be found to have contributed much to a scientific knowledge of the group Especially noteworthy were his identification of the adult form of one of the familiar and troublesome harvest bugs, his demonstration of a tracheal system in the group of mites named from the supposed absence of the system the Astigmata, and his description of the fossil arachnids from the Rhynie chert, the oldest known air breathing animals

For some years Mr Hirst's health had been unsatisfactory, and in 1927, under medical advice, he resigned his post at the Museum to seek relief in the drier climate of Australia While there he carried on his work on Acari, mainly at the University of Adelaide It would appear, however, that the relief was only temporary, and his death occurred while he was on his way home to England

W T C

News and Views

ON June 5 the Lord Mayor of London unveiled the third of the three windows which have been placed in the little church of St Ethelburga the Virgin, Bishopsgate, to the memory of Henry Hudson the explorer It was in this church that Hudson and his crew communicated on April 19, 1607, before setting out on his first voyage Three years later, in 1610, with faith undimmed by three failures, "he sailed from London in the *Discovery* and met his mysterious and tragic end His men mutinied and put their captain with eight of the crew out of the ship to perish That incident, which took place in June 1611, is the one chosen for the subject illustrated in the third window The first window, unveiled in 1928, was the gift of the Hudson Bay Company, the second was given by some American citizens, while the third is the gift of the citizens of the British Empire

THE firm of Messrs W H Allen, Sons and Co, Ltd, of Queen's Engineering Works, Bedford, has long been known for its systems of training both for engineers and workmen Engaged in the construction of high class machinery for power plants, pumping installations, and for naval and mercantile vessels, and employing some two thousand men, the firm has a constant need for highly trained engineers as well as skilled craftsmen, while the variety of work done provides wide experience for the beginner The

present head of the firm, Mr R W Allen, was president of the Institution of Mechanical Engineers in 1928, and in his presidential address he referred to the question of engineering training and education, which in the future, he said, would have three very important and difficult tasks First there was the problem of a suitable training for administrative and managerial positions, which involves not only a knowledge of scientific principles, technical applications, and workshop processes, but also calls for a knowledge of men and a broad view of industry, then there was the problem of the production of craftsmen through apprenticeship, and thirdly there was the training of boys other than craft apprentices This last category, he said, has been singularly neglected, "but we are realising to-day that from this class of entrant to industry there will be drawn in the future the great majority of the operatives of process work"

How Messrs Allen have solved these problems is explained in an illustrated booklet recently issued by them entitled "Engineering Training" Briefly, there are four schemes of training dealt with, known respectively as engineering pupilage, senior engineering studentship, junior engineering studentship, and trade apprenticeship, the first being suitable for the university graduate and the last for the elementary schoolboy Much information is given concerning the time spent in the various departments, the hours of work, wages, holidays, and the like, and an interesting coloured chart shows how the trade apprentice can become a student and how the junior student can become a senior student But a youth entering Messrs Allens' not only finds an excellent system of practical training laid down for him but also through the works Education and Welfare Department he is provided with courses of lectures on mathematics and science and on design and production, some of the lectures being given by the heads of departments There is also a Junior Engineering Society managed by the pupils, students, and apprentices, a past and present students' association, and everything is done to encourage healthy mental and physical culture The booklet is one which should be of use to all interested in engineering education especially as it embodies an account of a system worked out with great care which has stood the test of time

IN the earlier part of his presidential address to the Linnean Society of New South Wales, delivered at the annual general meeting on Mar 26 last, Dr H S Halcro Wardlaw reviewed the work of the Society during the past year The notable feature was the successful conclusion of negotiations for the erection of Science House by the Royal Society of New South Wales, the Linnean Society of New South Wales, and the Institution of Engineers, Australia The building is to be in Sydney on a site specially granted by the Government of New South Wales It will be a six storey building and, it is hoped, will be completed by the end of the year Another point of wide interest in Dr Wardlaw's address was that the Council of the Society has approved of a scheme to publish, two or more times a year, coloured plates of species of the Australian flora It was also stated that scientific societies have gained representation on the National Park Trust of Australia in the appointment of Prof T G B Osborn, professor of botany in the University of Sydney, to fill a vacancy The Government of New South Wales has again continued the protection granted to species of wild flowers threatened with extinction, while, as one result of Dr Walkom's attendance at the South Africa meeting of the British Association, the Society has taken steps to attempt to secure the setting apart of an area or areas for the protection, cultivation, and exhibition of the native flora

THE second part of Dr Wardlaw's address was devoted to a consideration of some aspects of the adaptation of living organisms to their environment Dr Wardlaw said that a characteristic feature of living organisms is the possession of mechanisms which protect them against the effects of changes of their environment These mechanisms in the earlier forms exert their action by restricting the interchange which they allow between the organism and its surroundings As they develop in efficiency, they become more selective in action, and are able to preserve the essential characters of the organism while allowing a free interchange with its environment As the complexity of organisms has increased, they have rendered themselves more independent of their external environment by providing their cells with an immediate environment of their own By this means external changes are only allowed to reach the cells in a modified form The evolutionary development of the adaptive mechanisms of the organism has continually extended the range and scope of its control over its environment Examples of the most highly specialised forms of this control are the maintenance of a constant body temperature by homoiothermal animals, and the provision of a special food supply for their young by mammals As the effectiveness of the mechanisms for the adaptation of the environment to its needs has increased, the use of adaptive modification of the organism itself has correspondingly diminished This is especially the case with man, in his ability to make tools, and in extending and increasing his control over his environment so much more rapidly than would seem possible by evolutionary modifications of bodily structure

DR B T DICKSON, the first Chief of the Division of Economic Botany, has issued his first annual report as director of the activities of this new scientific venture of the Australian Council for Scientific and Industrial Research (Pamphlet No 14, Melbourne, 1929) With, as yet, but few staff appointments made, and working in temporary quarters, the activities of this division can scarcely be regarded as fully under way, but the report indicates the lines on which work will be prosecuted, and records good progress, especially in research into some of the serious diseases attacking economic crops Dr Dickson outlines a programme of work which includes improvement of existing crops by controlling and eradicating disease, by selection and breeding, and by improved nutri-

tion; the introduction of new plants as the result of exploration or exchanges, and the testing of such plants; the control of weeds; the survey of the plant resources of the Dominion and the records of survey and improvement by adequate herbarium material. It is a comprehensive programme which indicates in an interesting manner the importance of scientific study of the flora of a country. Along some of these lines, as in most plant physiological questions, no start can be made until more resources in men and laboratories are available, but interesting sections of the report, such as that dealing with the effect of harvesting fruit when mature in controlling bitter pit in exported apples, show that on some lines the Division is already doing valuable work to justify the enterprise of the Commonwealth authorities in calling it into existence.

WE are glad that the General Electric Co. Ltd., following the example of several similar manufacturing firms, is now publishing a journal recording its many scientific and technical activities. The researches carried out in its laboratories at Wembley often pass over the borderland of engineering into that of pure science and are of special interest to the scientific world. They also help to keep the undertaking in close contact with the technical colleges and universities from which the Company gets the freshly trained minds necessary for the progress of the engineering industry. The first number is the May issue and it gives amongst other interesting articles a résumé of the electrical progress made during the year 1929. The national grid, 'talkies', illumination, broadcasting, and electric traction have provided numerous problems which the Company has successfully solved. A picture is shown of the plant at Wembley used for testing the great lattice towers used for the grid. Eight pulls of fifteen tons each are applied to them in one direction at various points and a further eight pulls of ten tons each are applied at right angles to the first set. Apparatus has been devised utilising photoelectric cells for the measurement of colour temperature and luminous output. As both temperature and lumen (candle power) scales are linear, the calibration of the apparatus is very simple. The very minute neon indicator lamps the Company has perfected, which take only the hundredth part of the current of an ordinary lamp, should prove useful for showing whether circuits used for cooking, heating, etc., are connected or not, and also for indicating in the dark the position of any object such as a switch. In addition, the Company makes ten kilowatt lamps for use in cinema studios each equal to 200 ordinary lamps. Details are also given of the large turbo alternators the Company constructed and of the 350 h.p. Diesel electric locomotives made for the India State Railways.

THE Annual Report of the Royal Scottish Museum for 1929 indicates the advance that one has come to expect from that progressive institution. Two new halls have been opened, one containing collections of European arms, the other beasts of prey, and exhibits are being prepared for a new gallery which is to be devoted to the illustration of evolution. For the second year in succession the number of visitors has exceeded half a million, and the average attendance on the three open hours of Sunday afternoon exceeds 4000, an indication of the popularity of the collections. It says little for the appreciation in which the Royal Scottish Museum is held in official quarters, that the annual report of this important adjunct to the education of young and old in Scotland should not be regarded as worthy of printing. The typewritten copies are unimpressive in appearance, awkward in size, and are unlikely to be stored away as annual reports of this kind should be, for comparison with their predecessors in tracing the development of the Museum.

THE national museums of Great Britain have still to formulate a serious policy for the encouragement of children, and while they hesitate or, as in the Royal Scottish Museum, make somewhat feeble and tentative efforts, it is informative to glance at another example of the progress made in the United States. A section of the Annual Report for 1928–29 of the Peabody Museum of Yale University is devoted to the Children's Department. A staff of three ladies is set aside by the Museum authorities for this work and an entire house has been acquired for the Department's use. The result is that on an average four classes a day from the schools in New Haven have been entertained and informed in the Museum. Of the 65 public schools, 55 have visited the institution for lectures or tours. In all, 455 groups have had the services of one or more *docents* in the Museum during the year, and in addition one of the staff has spoken to 130 classes in the city schools. It is a record which will bear abundant fruit in the interest which the children will take in the Museum and its collections in later years.

CONSIDERING the large number of waterfalls there are in Africa, it is at first sight strange that the total hydroelectric power generated there scarcely amounts to the output of a first class steam power station. When it is remembered, however, that there is little demand for power near any of the big falls, and that there are great seasonal and year to year variations in the flow of water, which would necessitate the construction of large and costly reservoirs, it will be seen that at present there is no great scope for commercial hydroelectric power stations. In certain parts of Africa the high evaporation from reservoirs is a serious drawback. There are water power stations at Katanga and Northern Rhodesia in connexion with copper mining. In South Africa, where great commercial developments have taken place, there is an abundant supply of cheap and easily worked coal. The Witwatersrand goldfield, for example, has an excellent coal field quite close to it. It is interesting to learn that the negotiations between the Tanganyika Government and the Power Securities Corporation for the development of the Pangani Falls have been satisfactorily concluded. The power developed at these falls is sufficient to provide the entire region of Tanganyika Territory between the Great Lakes and the Indian Ocean with electric power. The scheme appears to be a good one and cheap power would

stimulate agricultural and industrial development There is a small station at Dar es Salaam which uses fuel carried long distances by sea, but it is incapable of coping with the demand

A MOST important problem that electricians have to solve is to invent a device which will prevent the electric pressure between high pressure supply mains or between one of them and some other conductor from attaining such a value that a spark may ensue and the consequent arc cause a breakdown of the supply system The sudden rise of pressure may be due to atmospheric electricity, lightning discharges, or impulsive rushes of electricity due to a sudden alteration of the load on the network A great variety of lightning protective devices and electrical 'safety valves' are in use, but none is entirely successful Most of them want constant attention, and some of them are objectionable to have in a power station owing to the liquids they contain We are interested therefore to learn from a *Daily Science News Bulletin* recently issued by Science Service, Washington, D C, that a new material called 'thyrite' has been discovered which is practically an insulator at low voltages but becomes a conductor when the pressure is high The substance, we are told, includes carborundum, and a sample of it had a resistance of 50,000 ohms at 100 volts, and at 10,000 volts its resistance was half an ohm The change in the resistance appears to take place gradually and not suddenly It would therefore not be very useful as a safety valve between two high pressure mains It might be very useful, however, in some form of lightning protector Thyrite resembles black slate in colour and its mechanical properties are analogous to those of dry process porcelain In manufacturing, the material can easily be moulded to the shape required The contact surfaces are coated with metal by the Schoop metal spraying process

A CURIOUS problem of bird flotation was raised by F H Alexander at a meeting of the Challenger Society at Cullercoats on May 2 last He found that the body of a bird, without feathers, has a specific gravity nearly equal to unity, but since a bird does not float without its feathers, such a statement has little practical bearing He further stated, however, that the high freeboard with which most birds float is not easily accounted for, since actual measurements of the underwater volume of floating birds showed that they displaced a volume of water equal only to one third or even one-quarter of their own weight Various suggestions are made as to the powers which may aid ordinary displacement in supporting the bird—perhaps surface tension, perhaps special use of the internal air sacs, perhaps an unknown power of 'levitation' Our own impression is that Mr Alexander's data are faulty Birds have the power of raising their feathers at will, and in water-birds, in which the feathers are kept well oiled, this means a large increase of volume impenetrable to water, in other words, a much greater displacement than would be suggested by measuring a dead or living bird in the hand The only means of obtaining the displacement of a floating bird is by measuring the water displaced, and this simple check Mr Alexander has not employed Until that is known all speculation based upon calculations made upon a bird out of the water seems to us to be of little value

MUCH has been heard of the alleged Maglemose harpoons found by the late Beaumont Morfitt at Skipsea and Hornsea But surely their last appearance as genuine finds of the period claimed for them must be that in the *British Museum Quarterly* for April, where without a word of caution they are described as "mesolithic harpoons" The authenticity of the discoveries has always been doubtful There should no longer be any doubt if the new evidence brought forward by Mr T Sheppard in *The Naturalist* for May is accepted He states that a sister of the finder of the harpoons told him, in the presence of others, that her brother Beaumont made these harpoons from the leg bone of a red deer he had found in the peat, that he boiled them in glue, and invented the story of their discovery It is to be regretted that this story was not submitted to the Committee which inquired into the authenticity of the weapons

THE Society for Constructive Birth Control and Racial Progress founded a 'Mothers' Clinic' for the instruction of normally formed women in simple measures for the control of conception An analysis of data from ten thousand cases attending this clinic, compiled by Dr Marie Stopes, has been published Of the 10,000 women attending, 9912 were married, 5 only were unmarried and already mothers, and 83 were betrothed couples about to be married Among the cases, a considerable number desired the knowledge to enable them to space their later and desired children, and 142 childless women sought help towards securing pregnancy Valuable data have been secured of the numbers of pregnancies, live children, and miscarriages that have occurred among these women Cases with lacerations of the cervix uteri numbered 1321, this injury is prone to develop cancer, so that its early recognition and treatment are important

THE Prime Minister has nominated Mr J H Whitley, formerly Speaker of the House of Commons, to be chairman of the British Broadcasting Corporation in succession to Lord Clarendon, who recently resigned

EARL BUXTON, from 1914 until 1920 High Commissioner and Governor-General for South Africa, has been awarded the African Society's Gold Medal This medal is awarded from time to time to those who have rendered eminent services either for or in Africa Lord Buxton has been for ten years president of the African Society

SIR HENRY G LYONS, has been reappointed Director and Secretary of the Science Museum, and will hold that office until October, 1933 Sir Henry was originally due to retire last October, on attaining the age of sixty five, but was invited by the Board of Education to retain his post for a further year

THE Huxley memorial lecture of the Imperial College of Science and Technology next year will be delivered by Sir A Smith Woodward, on "Modern Progress in Vertebrate Palæontology," in the Royal College of Science, Exhibition Road, S W 7, on Monday, May 4, 1931, at 5 30 P M

THE Albert medal of the Royal Society of Arts for the current year has been awarded by the Council, with the approval of the president, H R H the Duke of Connaught, to Prof Henry E Armstrong, "for his discoveries in chemistry and his services to education" The medal was founded in 1863 as a memorial to Prince Albert, for eighteen years president of the Society, and is awarded each year "for distinguished merit in promoting Arts, Manufactures, and Commerce"

THE following appointments have recently been made by the Secretary of State for the Colonies Mr D W H Baker, to be superintendent of agriculture, Nigeria, Mr A B Harper, to be produce inspector, Nigeria, Mr A K Gibbon, to be assistant conservator of forests, Nigeria

THE Microscopical Society of Wales held its inaugural meeting at the Technical College, Cardiff, on June 4, when the following officers were appointed *President* Dr H A Harris, *Vice Presidents,* Dr David Hepburn, Mr Clarence A Seyler, *Chairman,* Dr James Beatty, *Secretary,* Mr Alfred E Harris, *Committee,* Mr J Malcolm Davies, Mr Donald Hicks, Mr W T Lane, Eileen Melville, Mr E A Rudge, Mr J H Wilson, *Treasurer,* Mr L Osborne Davis The office of the Society is at 27 Park Place, Cardiff

THE reviewer of "The Time Journey of Dr Barton," in NATURE of May 31, while sympathising with the prospective developments described, remarked that the work "does not face the real issue", that is, the manner in which individual rights, aims, and prejudices are to be co ordinated for obviously desirable ends Mr John Hodgson, the editor of Dr Barton's manuscript, writes to say that Chap xxix (entitled "The New Control") is devoted to the consideration of this vital point

A PARAGRAPH in our "News and Views" columns of May 31 recorded a television performance given before an audience of 500 people in New York The screen used was six feet square A note from the Baird International Television, Ltd, 133 Long Acre, W C 2, reminds us that television was projected upon a large screen in England so far back as December 1928, when Mr Baird showed images on a screen 4 ft by 4 ft At present sight and sound are being broadcast daily by the British Broadcasting Corporation, and Great Britain is the only country in the world which has an official and regular service of broadcast sight and sound, and where 'televisors' are available to anyone who cares to purchase them

THE Report of the Water Pollution Research Board for the year ended June 30, 1929, has been issued (Dept Sci Ind Research London H M Stationery Office, 9*d* net) It contains the report of the director of water pollution research with details of investigations on the purification of beet sugar factories' effluent It is believed that by a process of biological filtration more than 90 per cent purification of beet sugar factory effluents can be effected

WE have received catalogues of second hand microscopes and accessories and of 'optical utilities' from Messrs W Watson and Sons, Ltd (313 High Holborn, W C 1) The former includes objectives having the exceptionally high N A of 1 5 and 1 6, also recent microscopes and accessories and books, the property of a distinguished microscopist Among 'optical utilities', the 'window telescope', the 'Univis' bi and tri focal spectacle lenses, and the 'Speera binocular magnifiers are of interest

THE causes of neo natal death is the subject of a report by Dr J N Cruickshank issued by the Medical Research Council (*Special Rep Series,* No 145 London H M Stationery Office, 1*s* 6*d* net) In 800 cases of neo natal death (that is, death of the infant between birth and the end of the fourth week) examined, the cause of death was considered to be birth asphyxia, birth injury, or prematurity in 540 cases, infective conditions in 238 cases, and gross developmental defects in 22 cases Asphyxia at birth is thus an important cause of neo natal death, and Dr Cruickshank devotes a section of his report to a consideration of recent advances in the treatment of the condition

THE Ministry of Health has issued an eighth report of the Advisory Committee on the Welfare of the Blind, 1928-29 (London H M Stationery Office 6*d* net) The total registered blind population of England and Wales in 1929 is 52,727, as compared with 46,822 in 1927 and 30,785 in 1920, being ratios to the general population of 1 749, 1 835, and 1 1219 respectively It is considered that this apparent increase is mainly due to better registration and not to an actual increase of blindness Juvenile blindness (0 5 years) has not increased but has remained almost uniform during the last five years The bulk of the increased number of blind persons is accounted for by the increase among those above fifty years of age, and it is suggested that there is a fruitful field for inquiry into the whole question of the care and preservation of the sight of the adult population

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —Forest officers and estate officers, each on probation, under the Forestry Commissioners—The Secretary, Forestry Commission, 22 Grosvenor Gardens, S W 1 (June 16) A radium custodian for the Hull Radium Trust—The Chairman, Hull Radium Trust, Royal Infirmary, Hull (June 17) A woman assistant in the Agricultural Department of the Surrey Agricultural Committee, to work under the small livestock instructress, and an assistant instructor in agriculture in the Agricultural Department of the Surrey Agricultural Committee—The County Agricultural Officer, Agricultural Department, County Hall, Kingston on-Thames (June 18) A lecturer in electrical engineering at the Dudley Technical College—The Director of Education, Education Offices, Dudley (June 19) An

assistant lecturer in geography in the University of Durham —The Secretary of Council, University Offices, North Bailey, Durham (June 20) A lecturer for biology, general science, and hygiene at the Kenton Lodge Training College for Women, Newcastle upon Tyne —The Director of Education, Northumberland Road, Newcastle upon Tyne (June 21) A teacher of mechanical engineering subjects at the Technical College, Wolverton —The Principal, Technical College, Wolverton, Bucks (June 23) A head of the Building Department of the Birmingham Central Technical College — The Principal, Central Technical College, Suffolk Street, Birmingham (June 25) An assistant lecturer in mathematics at the Brighton Technical College —The Secretary, Brighton Education Committee, 54 Old Steine, Brighton (June 28) A lecturer in electrical engineering, and an assistant lecturer in mechanical engineering, at the Manchester Municipal College of Technology—The Registrar, College of Technology, Manchester (June 28) A technological chemist under the Ceylon Coconut Research Scheme, for work on the chemistry of the coconut and its commercial products —The Agricultural Adviser to the Secretary of State for the Colonies, 2 Richmond Terrace, Whitehall, S W 1 (June 30) A lecturer in mathematics at the Northampton Polytechnic Institute —The Principal, Northampton Polytechnic Institute, St John Street, E C 1 (June 30) An assistant Government analyst for Hong Kong —The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S W 1 (June 30) Junior assistants at the National Physical Laboratory — The Director, National Physical Laboratory, Teddington (June 30) Three research fellowships at the Onderstepoort Veterinary Research Laboratory, Pretoria, respectively for work on tissue culture and filterable viruses, bacteriology, and the physiology of animals, especially ruminants, and the extraction of toxic substances from plants and the determination of the nature of such substances— The Secretary, Empire Marketing Board, 2 Queen Anne's Gate Buildings, S W 1 (Sept 1) A junior assistant chemist under the Research Association of British Flour Millers—The Director of the Association, Old London Road, St Albans Teachers for evening classes in physics, heat, light, and sound advanced, photography, building construction, geometry, and graphics for building students, calculations for builders, building science, and for plaster work, at the Woolwich Polytechnic—The Principal Woolwich Polytechnic, S E 18 A laboratory assistant in the Research Department, Woolwich—The Superintendent, Research Department, Woolwich, S E 18

Our Astronomical Column

Absolute Motions of Stars - *Astr Nach* No 5696–5697 contains a catalogue of the absolute velocities of 1937 stars, by R Klumak and F Hecht The radial velocities are taken from J Vouto's Second Catalogue of Radial Velocities (Lembang Observatory, 1928) The solar motion is assumed as 19 7 km /sec towards R A 270°, N Decl 30° 28′ (1900) This is taken out of the stellar motions, which are therefore absolute as being referred to the mean of the stars in the neighbourhood of the sun But the general motion of these stars round the galactic centre is not considered The parallaxes have been slightly modified where necessary, to make them accord with the adopted absolute magnitudes of the stars The proper motions in R A and Declination are then reduced to km /sec and combined with the radial velocities The resultant velocities are tabulated and the Right Ascension and Declination of the points to which they are directed The catalogue contains a number of stars of abnormally high velocity, as these have naturally attracted the special attention of observers

Work of the Naval Observatory, Washington — Volume 12 of the publications of, this Observatory is mainly occupied with equatorial observations of various objects, there are series of observations of the satellites of Mars and Saturn, and discussions of them for the improvement of their orbit elements Numerous comets and minor planets were observed, their positions are given from 1908 to 1926 The photoheliographic observations of sunspots extend from January 1917 to the end of 1927

The determination by wireless signals of the difference of longitude between Washington and San Diego, California, which was made in the autumn of 1926, as part of the international series of longitude determinations, is described in detail The observatory also controlled the sending of the wireless signals from Annapolis and Bellevue, near Washington, and made arrangements for those sent from Honolulu Small transit instruments were used, they were placed in the open air The transits were all made by the travelling wire method, this practically eliminates personal equation, so that interchange of observers is not necessary The amount of this equation was, however, determined by personal equation machines, and applied to the results of each observer The resulting difference of longitude between Washington and Paris is 5 hr 17 min 36 665 sec with a probable error of only 0 002 sec, it is 0 013 sec greater than the value obtained in 1913–14, also by wireless, but receiving the signals by ear None of the determinations in the series has a greater error than 0 003 sec, it will be remembered that in pre wireless days the difference between the English and French determinations of the longitude Paris Greenwich went into the first decimal

Spectroscopic Study of ξ Ursae Majoris —Mr Louis Berman investigates this system in *Publ Ast Soc Pacific* for February The star is a well known visual binary with a period of 60 years, and both the components are spectroscopic binaries The brighter component has the long period (for spectroscopic binaries) of 669 18 days, that of the fainter star is determined by Mr Berman as 3 9805 days Only one spectrum is visible, so the ratio of masses cannot be determined The eccentricity of the orbit is very small, and it has been treated as circular, $a \sin i$ is equal to 275,860 km The parallax 0 131″ is derived from the combination of the radial velocities of the components A, B This is in good accord with the value 0 123″ adopted from direct measures It is noted that the stars A B will be so close to each other until about 1940, that it will be impossible to obtain separate spectrograms of the two components, Mr Berman therefore considers this a suitable time to summarise our knowledge of this interesting system The spectroscopic observations determine which of the two possible positions of the plane of the visual orbit is the correct one

Research Items

Dental Morphology of Prehistoric Guam.—A collection of crania obtained by Dr J C Thompson and Mr H G Hornbostel in 1922 from Guam, one of the Mariana Islands in Micronesia, and now in the Bernice P Bishop Museum of Honolulu, has been examined by Dr R W Leigh, who publishes his results in vol 11, No 3, of the Museum's *Memoirs*. The crania are of pre Spanish or early post Spanish origin and belong to a homogeneous group which was probably inbred. The ancient Chamorros, as the inhabitants are called, lived exclusively on the fauna and flora of the island, a fact of importance in relation to the pathology of the teeth. Early navigators said they did not eat meat of any kind, though they had fowls and kept doves in captivity. Nor were they cannibals. They chewed betel but did not make use of fermented beverages. The teeth are well formed, the average dental index being 42 6, the group tending to the mesodont. Five per cent evidence slight developmental disturbance. Ethnic deformation was practised to a limited extent by filing on the facial surface of the six superior anterior teeth. Staining the teeth orange to black was customary. Owing to betel chewing there was a permanent discoloration of the enamel and a predisposition to degeneration of the investing dental tissues. The lime used produced enormous accretions on the teeth. Owing to the habit of chewing and the soft character of the food, there was a high incidence of periodontoclasia, the chronic destructive degeneration of the investing tissues of the teeth which eventuates in exfoliation. This was the major cause of the loss of teeth in later life but no person deceased before thirty years of age had lost any teeth; 18 per cent showed dental caries.

Destruction of Rats by Red-Squill Powders.—An ideal poison for rats must be effective, safe to use, and cheap. The ordinary rat poisons (strychnine, arsenic, phosphorus, and barium carbonate) are dangerous not only to domestic and wild animals, but also to human beings, and the U S Department of Agriculture has carried through tests with powders made from squill (*Urginea maritima*) (U S Dept Agr, *Tech Bull*, No 134). The results confirm E G Boulenger's work at the London Zoo, and the advice given in the British Ministry of Agriculture and Fisheries leaflet on the destruction of rats. It was found that red squill powder is toxic to rats, while white squill is not. Cats, dogs, chickens and pigeons are not seriously harmed by squill powders, since food so poisoned is either refused or, if eaten, is promptly vomited. Powders prepared by directly drying unfermented, sliced red squill bulbs in an oven at 80° C are usually more toxic than those prepared in any other way, the lethal dose being about 250 milligrams per kilogram of body weight for white rats, and rather less for wild brown rats. Variation in toxicity makes it desirable that squill powders should be tested before being marketed, and adjusted to a standard, 10 grams of 10 per cent squill bait to kill a minimum of 1 kilogram of rat.

Blood of the Eel.—Mr Nobuyuki Kawamoto contributes two papers to the fourth number of vol 4 of the *Science Reports of the Tôhoku Imperial University* (Fourth Series (Biology), Sendai, Japan, December 1929. "Physiological Studies on the Eel I The Seasonal Variation of the Blood Constituents II The Influence of Temperature and of the Relative Volumes of the Red Corpuscles and Plasma upon the Hæmoglobin Dissociation Curve"). In both researches the common eel, *Anguilla japonica*, was used. It was found that the relative volume, number of corpuscles, viscosity, and iron content increase as soon as hibernation begins and decrease as it approaches its end, but, on the other hand, the non protein nitrogen is much less at that time and increases in summer with the rise of temperature and period of growth. In the second paper it is shown that the hydrogen ion concentration of the blood was constant during 43 days of starvation. The oxygen capacity is directly proportional to the relative volume of red corpuscles, the volume varying much in the eel. Less oxygen is taken up by the blood when the temperature becomes higher, thus agreeing with previous work on other animals. The author concludes from the greater amount of heat produced during chemical reaction between oxygen and hæmoglobin that the blood of the eel possesses greater affinity for oxygen than that of the frog or man.

Differentiation of Sex.—In a summary article on the differentiation of sex in vertebrates, Dr Rogers Brambell (*Sci Progress*, April 1930) begins by accepting the sex chromosomes as a primary mechanism of sex determination firmly established, and then goes on to point out that while they are normally the decisive factors, yet other equally potent factors are at work. The fact that in *Drosophila* super males and super females as well as intersexes are produced when there is a lack of balance between the number of X chromosomes and the number of sets of autosomes shows that the latter play their part in determining sex. By crossing different geographical races of the gypsy moth (*Lymantria dispar*) Goldschmidt has obtained intersexes which led finally to the hypothesis that the Mendelian sex factors are quantitative, that racial variations occur in them, and that a time factor in their expression during development is also involved. It has long been known that the sex ratios of frogs in some localities are abnormal, and subsequent research has shown that some males develop testes directly, while in others they arise from transformed ovaries. The frequency of these two types of males differs in various localities. Witschi has shown by crossing hermaphrodites that the male frog is heterogametic (XY), and it appears that the indirect form of development depends upon a delay in the time at which the male determining stimulus becomes effective. Environmental factors as well as the time element, also play a part. Intersexes in pigs, the inheritance of which has been studied, and of the histology of which Brambell describes a case, again involves a time factor as well as quantitative sex differences, the ovotestes of pigs being accounted for by the abnormally late appearance of the male determining stimulus.

Development of *Callichthys*.—Miss Frances M Ballantyne in a paper entitled "Notes on the Development of *Callichthys littoralis*" (*Trans Roy Soc Edinburgh*, vol 56, part 2 (No 18), 1930), describes in detail the embryonic development of this very interesting South American siluroid. An unusually complete series of eggs and embryos collected by Dr G S Carter on his expedition to the Gran Chaco was available for this study. *Callichthys* makes a nest of leaves, and the eggs are carefully guarded by both male and female until the tadpole-like young are hatched. The process of segmentation is like *Salmo*. The embryo is far advanced when it emerges from the egg. Gill breathing is helped by the intestine, the caudal and dorsal fins probably taking part, especially in the early stages when they are very

vascular In development it resembles the Dipnoi in certain points, in others it is like *Polypterus* In many ways it is a typical teleost The paper is very well illustrated by clear diagrams in the text and by plates representing the various embryonic stages with reconstruction of the chondrocranium

Chromosome Linkage in *Œnothera* —An important paper on meiosis in *Œnothera* has been published by Mr D G Catcheside (*Trans Roy Soc Edinb*, vol 56, No 19), who has made a study of *Œ pycnocarpa*, *Œ nutans* ($2n=14$) and a triploid mutation of *pycnocarpa* He shows that in all three the chromosomes are arranged end to end in a closed ring Ishikawa, in a study of embryo sacs and fertilisation, found a case of dispermy in a hybrid between *Œ pycnocarpa* and *Œ nutans*, and the triploid *pycnocarpa* (with 21 chromosomes) is regarded as probably arising in this way, through the union of two male nuclei with the egg nucleus The fact that its chromosomes are in a closed ring of 21 is opposed to the hypothesis of parasynapsis in *Œnothera* On the heterotypic spindle in the triploid the chromosomes take up the zigzag arrangement characteristic of *Œnothera*, but always with irregularities Later, they separate usually 10 11, thus confirming an early account of Gates for triploid Œnotheras In the triploid, one of the three sets of chromosomes must be present in duplicate, and yet there are no free pairs of chromosomes This appears to upset the hypothesis that ring formation is contingent upon a heterozygous condition of the chromosome complement Catcheside supports the view that chromosome linkage is inherited as a genetic character determined by one or more genetic factors He shows that this hypothesis is in accord with the numerous cases of linkage thus far described

Proteolysis in Plants —Botanists will welcome warmly a brief restatement of his experimental investigations of the proteases of plants and of his conclusions therefrom, which Prof S H Vines has been moved to prepare (London Macmillan and Co, Ltd, 1930) as the result of making acquaintance with the rather different views on protein digestion by enzymes that have been advanced of recent years by Prof Willstätter and his collaborators In these later papers the different behaviour of different plant extracts to the protein substrate has been traced to the different activation in the different solutions of the same enzyme system, so that in one case it may attack fibrin, in another peptone, whilst the production of amino acids, such as tryptophane, during digestion was attributed to the decomposition of peptides by a peptidase Vines, on the other hand, thought that he had given good experimental grounds for the separation from some plant extracts of two enzyme systems, a peptase attacking proteins such as fibrin and an ereptase attacking peptone, producing from it amino-acids including tryptophane Vines restates succinctly the experimental grounds which led him to the conclusion, the paper is a very clear summary of his series of papers in a difficult field and is of value as putting the two alternative points of view clearly in contrast

Cretaceous Mollusca of South Africa —The species of *Trigonia*, which were so numerous and widely distributed in Mesozoic times, were divided by Agassiz into eight sections, to which three others have been added by later workers Following the present tendency to divide large genera into smaller groups, Dr E C N van Hoepen (*Palæont Navors Nas Mus Bloemfontein*, 1, 1, 1929) has proposed nine new genera for the species of *Trigonia* found in the chalk of Zululand Further and prolonged study of the species in other formations and countries is needed before the phylogenetic significance of these genera can be regarded as established J V L Rennie, in a paper on the Cretaceous fossils from Angola (*Ann S African Mus*, 28, 1, 1929), describes a number of new lamellibranchs and gasteropods from the Albian and Senonian, and points out the close relationship of the Senonian forms to those found in Pondoland and Zululand In another memoir the same author (*ibid* 28, 159, 1930) enlarges our knowledge of the molluscan fauna of the Senonian of Pondoland

Rotary Oil-Well Drilling Plant —The rotary system of drilling oil wells is now so well known and so securely established in practically all the oilfields of the world, that it would seem almost superfluous to describe other than revolutionary features But the last year or two has witnessed some of the most striking engineering feats in oilfield development that are on record, more particularly in connexion with deep holes, carried actually to depths of nearly 10,000 feet Since the rotary system of drilling has been responsible for such achievements, it is only natural that the recent modifications and developments of this time honoured plant should receive notice, and in Mr Neils Matheson's paper, read before the Institution of Petroleum Technologists on April 8, he did full justice to the means by which such results have been achieved The author described some of the latest types of drilling machinery designed to procure both deep and straight holes, the latter of almost equal importance to the former from a geological point of view Among the alterations noted are the increase of the size of the drilling rig to 136 feet (100 feet was considered quite a fair average only a few years ago), increase in derrick floor space to 26 feet, and replacement of standard 'band' and 'calf wheels' by secondary 'draw works' In other directions an important advance is made by replacing cast iron by 'electric steel', that is, cast iron made from 30 100 per cent steel scrap, and generally strengthening all materials employed both in plant and superstructure Labour saving devices are lavishly introduced and the problem of safety of the drillers—often conspicuously neglected in extra American oilfields—has received expert attention The evolution of the rotary oil-well drilling plant clearly has not come to a standstill, and as the demand for accurate rather than speedy drilling is increased, so we may expect a correspondingly high standard in design and efficiency of this extremely adaptable means of producing petroleum

High Voltage Electrometer —In the issue of the *Physikalische Zeitschrift* for April 1, Prof T Leodor Wulf of the College of Falkenburg describes a new filament electrometer which can be used for the measurement of high voltages About 2 cm of Wollaston wire is mounted vertically about 0 2 cm in front of a vertical strip of metal and the wire is kept stretched by quartz springs at its ends The strip and wire are mounted in a metal case from which they are insulated by a sulphur plug A metal sphere 6 cm in diameter projects into the case and its centre may be placed at any point on a perpendicular to the strip through the centre of the filament When the voltage to be measured is applied to the sphere, the filament is charged by induction and is attracted towards the sphere The motion of the centre of the wire is dead beat and is observed through a microscope from the side When the filament and strip are connected to the case, the instrument will measure up to 50,000 volts When filament and strip are insulated from the case and the voltage is applied

directly to them, the instrument will read down to 1 volt The instrument can be arranged for photographic reproduction of the motion of the filament, and several photographs are given in the paper

A Simple Transmission Dynamometer—In *Engineering* for May 16, Messrs E Giffon and C M White describe a new form of transmission dynamometer which has been in use for the last six months in the Engineering Laboratory of King's College, London Dynamometers for the measurement of the power consumption of any machine are generally of the torsion meter type, depending for their action upon the twisting of a shaft Such apparatus has to be delicate, needs careful handling, and requires considerable space The dynamometer described was designed to overcome these disadvantages, and tests of the instrument show that it is robust, fool proof, compact, and accurate In this apparatus power is transmitted by a spur wheel on the driving shaft to a spur wheel on a lay shaft This lay shaft also carries a sprocket wheel over which runs a chain, driving a sprocket wheel on this driven shaft The gear is enclosed in an aluminium case carrying ball bearings, and an extension of this case forms the torque arm, on the extremity of which weights can be placed Designed to transmit 10 h p at 2000 r p m, the dynamometer was tested by a comparison with a friction brake of the band type, and the results are given by a series of curves included in the article, which also gives illustrations of the apparatus

Direction Finding by Radio—Mr R H Barfield read a paper on April 2 to the Institution of Electrical Engineers (Wireless Section) on recent developments of direction finding apparatus This paper describes the results obtained when carrying out part of the programme of work mapped out by the Radio Research Board It is well known that direction finding apparatus of the closed loop type determines only the horizontal magnetic field of the radio waves To get over this difficulty, Adcock devised a receiving system of spaced vertical aerials This system, modified so as to produce a balanced effect, has been tested over a long period It was calibrated by means of a transmitter attached to a kite which sent waves at a known downcoming angle and with known polarisation The results prove that the flatness of the minima obtained with direction finding apparatus at distances exceeding twenty miles was undoubtedly due to downcoming waves Direction finding is possible on a wave length of 24 metres up to a distance of 70 miles in the daytime and 30 miles at night in the summer season Up to a distance of 20 miles the bearings are sharp and accurate to within 2° provided a good open site is found A site which is clear of obstables to a hundred yards in all directions would be very suitable At distances greater than 20 miles the minima are not nearly so sharply defined At greater distances than 500 miles, the Adcock system gives indications of bearings within about 5°, but the loop direction finder is practically useless The former system is much less affected by errors due to downcoming waves At close ranges where the downcoming radiation is weak, the loop direction finder is to be preferred as it is more compact, robust, and portable

The Decomposition of Nitrogen Pentoxide—The rate of decomposition of nitrogen pentoxide has recently been the subject of a number of investigations and the results are somewhat divergent In the April number of the *Journal of the American Chemical Society* there are two papers by Eyring and Daniels in which the rate of decomposition in inert and in chemically active solvents, respectively, is discussed on the basis of new experiments In the inert solvents the decomposition was found to be strictly unimolecular, and the small differences in velocity caused by a change of concentration (from 0 1 to 1 8 molar) or of solvent, are thought to preclude the possibility that the reaction is complicated by traces of catalysts The value of $1/2s$, where s is given by the equation $k = se^{-E/RT}$, is thought to represent, to a first approximation, the time taken for two atoms or groups at a valency bond to separate after activation, that is, the natural vibration period in the valency bond which is to break It is predicted that s will approach an approximate constant in nearly all unimolecular reactions In the case of chemically active solvents (nitric acid, propylene chloride, carbon disulphide, acetone, iodine) the results are specific and their interpretation is difficult, although solvation appears to play some part

Fabrics Research We have received the second report of the Fabrics Co ordinating Research Committee (Department of Scientific and Industrial Research, London H M Stationery Office, 1930, 5s net) which contains detailed reports on the fire proofing of fabrics, the action of sunlight on cotton, the waterproofness of 'porous' waterproof fabrics, the tensile test of fabrics, and the deterioration of fabrics by micro organisms The first report was published in 1925 The introduction to the report, written by the chairman of the committee, Dr R H Pickard, gives a useful summary of the contents of the volume, from which it is evident that research work of great thoroughness and value has been carried out The individual sections contain many tables and curves, and full bibliographies That on fire proofing, in particular, is of very wide interest, and is probably the best guide on the subject in existence Important results were obtained with borax and boric acid mixtures The mixture was found to be much more effective than either substance separately In the section on the effect of sunlight on cotton, use was made of the known fact that cotton after oxidation yields solutions in cuprammonium possessing a lower viscosity than similar solutions of the original fibre The action of sunlight in the presence of air is probably an oxidation process similar to that due to chlorine All the reports have important practical bearings, and the volume is one which will prove valuable in many aspects

Thermal Data on Organic Compounds—The April number of the *Journal of the American Chemical Society* contains a paper by Huffman, Parkes, and Daniels, giving the results of experiments on the specific heats and latent heats of fusion of a number of aromatic hydrocarbons The entropies have in some cases been calculated from these data, and found to agree with the equation $S_{298} = 25\ 0 + 7\ 7n - 4\ 5r + 19\ 5p$, where n is the total number of carbon atoms outside the benzene ring, p the number of phenyl groups in the compound, and r the number of methyl branches attached on the main aliphatic chain of the molecule A similar equation had been found to hold for liquid paraffins $S_{298} = 25\ 0 + 7\ 7n - 4\ 5r$, where n is the number of carbon atoms in the molecule and r the number of methyl branches on the side chain The free energies are also calculated, and ortho, meta, and para-isomers are considered to have practically identical free energies of formation The free energy of hydrogenation of benzene to form cyclohexane was calculated in two different ways, the results being in agreement The work was undertaken at the instance of the American Petroleum Institute

South-Eastern Union of Scientific Societies

CONGRESS AT PORTSMOUTH

THE thirty fifth annual Congress of the South Eastern Union was held at Portsmouth on May 28–31, at the invitation of the Lord Mayor and the City Corporation, the Portsmouth Literary and Philosophical Society, and the Portsmouth Geological and Archæological Society, with Mr O G S Crawford in the presidential chair in succession to Sir Arthur Keith

The meetings were held in the Municipal College and in the Guildhall, where the city plate were exhibited and explained by Mr J Hutt, the Chief Librarian In the Congress museum, held in the room of the Portsmouth Gas Company, many local objects were shown, the most striking being the prehistoric relics exhumed by Col J H Cooke from burials on the Portsdown Ridgeway, notably amongst them being a fine flint dagger of Solutré, a type found with the bones of a bronze age warrior of great stature An unusually interesting perambulation of Old Portsmouth was conducted by Mr R Pook, who had prepared a booklet for the occasion

The president, who is the well known Archæology Officer of the Ordnance Survey and the editor and founder of *Antiquity*, took as the title of his address, "What is Archæology?" He finds that few really realise what archæology is, and many papers written on the subject are really history, but there is a period of about a thousand years after Caesar's invasion in which the two overlap Anthropology, being the study of man, may deal with both history and archæology There is history of which but for the archæologist we should never have heard Such is, for example, the Minoan civilisation of Crete and although we have a dim reflection in the Iliad and the Odyssey of an early civilisation, we should have known but little of it but for the discoveries of Schlieman Archæology is a method of reconstructing the past, so far as man is concerned in it, and it replaces or supplements history Archæology is a hobby, but the student of it does not always do the actual digging as he often has to give lectures in order to raise the money for his work Mr Crawford emphasised the point that the æsthetic preserver of ancient structures must exercise moderation in his desire, since all that is ancient is not always beautiful and worth preserving Age and beauty are not necessarily associated The march of progress cannot be withstood, and the love of old things because they are old is in practice an attitude impossible to maintain We must adapt ourselves to modern developments The practical policy is to endeavour to preserve certain large areas of uncontaminated countryside as national playgrounds, so that in days to come our descendants may know what England once looked like A few uninhabited tracts so preserved would amply compensate for the loss of a few ruins or antiquities, the preservation of which may be found to be impossible

In field work Mr Crawford finds Great Britain supreme, whilst in the new science of air archæology it is not only supreme it stands alone An eloquent plea was made for the accurate naming of specimens, and also for the placing in a local museum of isolated finds that are often lost through being retained in private hands When Mr Crawford was excavating in the Sudan, one of his best workmen was a retired cannibal He had a lively imagination, but it was grounded in the hard school of life and fact He would have been an active if unconventional fellow of the Society of Antiquaries It is none too easy to reconstruct the conditions of prehistoric society, and almost impossible without some experience of a kindred society now functioning Prehistoric man's attitude to life was a severely practical one, he was fundamentally lazy, and he never did things that he would consider useless to himself The older archæologists were obsessed with the idea that ancient man was always at warfare, and forgot that the quest for food came first The struggle for existence was a real one, and warfare as a means in the struggle would have been useless unless there were loot to be got The face of England is a palimpsest The pattern in which it is laid out is the result of a long process of evolution The old patterns have to be traced under the new We are only now beginning to realise what immense possibilities underlie the latest development of archæology, that of air photography

In the Archæological Section a paper by Prof L S Palmer revealed some striking correlations between the pre history of Hampshire and Africa Like other travellers, Prof Palmer was struck by the consistency of the evolutionary forms of the flint artefacts with those that have been established in European countries and found that Hampshire was no exception Much attention was given to the Raised Beach terraces and the Coombe Rock overlying them in the coastal plain extending from southern Hampshire eastward into Sussex, and, following a paper by Col J H Cooke, excursions to view these formations *in situ* were carried out Near Westbourne Common a gravel pit revealed a series of pipes eating into an extensive mass of pounded and reconstructed chalk which here represents the Coombe Rock It is hoped that the Raised Beach will eventually be found below it M L'Abbe Breuil was a distinguished visitor amongst the party In the Coombe Rock of Emsworth Woods many split pebbles of distinct Blackheath Pebble Bed type were found, with the usual jasper like colour and with the pounded surface markings How they came here remains a problem

In the Botanical Section Col Wolley Dod's "Experiences of a Field Botanist" proved extremely interesting, and the report of the work of the Section showed that considerable progress has been made in the botanical survey of Sussex, which was commenced at Hastings in 1927 under the ægis of Dr A B Rendle Ashdown Forest is now particularly under examination, and a beginning has been made of the western area

In the Zoological Section Mr John F Marshall gave an account of the important work that is being done at the Mosquito Control Institute established by him at Hayling Island, and revealed to many this little known organisation of a great national service A record of intensive research work was given by Miss G F Selwood in her paper on "Fauna Changes in a Bog at Bembridge"

In the Regional Survey Section Mr D Halton Thompson gave an account of the sources of the water-supply of Portsmouth, and showed that most of the water came from the folded chalk, and little from the syncline in which the older Eocene beds lie north of Portsdown Mr G E Hutchings showed "Some Applications of Regional Survey in Education", and Mr A Farquharson gave the results of "A Regional Survey of Chichester"

Geologists and botanists concluded their visit to Portsmouth with an excursion to Whitecliffe Bay, Isle of Wight, where both branches of parties found much to record in the tertiary clays, sands, and limestones of that interesting spot

Members of the Congress attended a reception given by the Lord Mayor in the spacious Guildhall, and received every assistance and welcome from their hosts the municipal authorities

Leeds Meeting of the Institution of Gas Engineers

THE Institution of Gas Engineers met in Leeds for its annual meeting on June 2–6, under the presidency of Mr C S Shapley, manager of the Leeds Gas Department Several of the papers dealt with questions of actuality in the world of carbonisation

Mr E G Stewart examined the "Functions of Coke Ovens" in a paper of great interest in view of the recent issue of the report of the Area Gas Supply Committee His analysis revealed that only about four British gas undertakings are large enough to consider the installation of such plant, although a group of smaller undertakings might do so The coke ovens should rationally be attached to iron and steel works, which need the gas as fuel If that were generally the case, there would be no coke oven gas to spare As gas making plant, the coke oven is not superior to the modern vertical retort, which is more flexible The development of coking plants increases the pressure on the coke market, which will be intensified if the gas works purchase spare gas This points to the need for an understanding between the two industries for the marketing of both main and by products

The need for greater freedom in constructing the tariffs for the sale of gas was emphasised so that differential prices might be charged according to the incidence of the load Indeed the freedom to rationalise the charging for gas was advanced on all sides as an essential preliminary to rationalising the supply of industrial gaseous fuel

Dr E W Smith summarised the experience gained in the process of dehydrating coal gas before distribution This is a notable innovation introduced into practice by a British firm in 1925 By washing the gas with a strong solution of calcium chloride (glycerine has also been proposed) about two thirds of the water normally present in coal gas is removed The principal advantage is that the dew point of the gas is so far reduced that liquid water is never deposited in the mains and consequently corrosion of mains and meter etc, is almost entirely prevented Stoppages due to water and ice are avoided in winter, and many other advantages accrue, so that plants for the purpose are being erected with great rapidity and the practice is being adopted in foreign works

Mr F Prentice described three years' experience with a waterless gasholder, of which a few already exist in Great Britain The first was erected about fifteen years ago in Germany, where these holders are now numerous—indeed they are probably the most characteristic feature of the landscape in the Ruhr valley The normal gasholder consists of a bell floating in water, but these consist essentially of a vertical cylinder closed by a piston, which rises and falls as the volume of gas in the holder changes The piston is made gas tight either by a tar seal or a grease joint at its periphery where sliding contact is made with the walls Hailed at first as a piece of crazy engineering foredoomed to failure, a few years have falsified practically all of the prophecies, and many more will be seen in the future The Ipswich holder, which is 202 ft high, is only a small one and the large examples are undoubtedly wonderful engineering constructions

A paper by Mr C F Broadhead of Melbourne dealt with the production of a new road binder—bitural The paper has a bearing on the problem of current importance to all carbonising industries There is an over production of tar, with consequent difficulty in marketing in the face of mineral road making materials bitumen and oil pitch It is said that the tar from modern vertical retorts is not so good a road making material as the old tar Mr Broadhead attributes this to the large proportion of unsaturated hydrocarbons in vertical retort tar, and proposes to polymerise these by an oxidation in the presence of an accelerator which induces condensation of the unsaturated hydrocarbons with phenols to form larger molecular aggregations The tar is substantially altered in chemical character, and is said to have given satisfactory results in Australia as a road making material

The paper by Messrs W H Hoffert and G Claxton on benzole recovery in gasworks practice discussed the important question as to whether it is worth while to remove benzole from town's gas for use as motor spirit It has generally been assumed that it was not, and relatively little is so obtained The view is being challenged as the result of faulty costing and the gas works will probably become much more prominent in this direction The refining of benzole involves a loss of good fuel which has long been recognised as a challenge to the inventive The authors detailed their method of adding to the crude spirit suitable anti oxidant inhibitors to prevent the formation of objectionable gums which result from the polymerisation of unsaturated hydrocarbons essentially an oxidation process This is an interesting piece of chemistry which promises to be of great practical importance to the motor spirit industry

Dr Margaret Fishenden's paper was a collation of methods for handling heat transmission calculations In particular she gave the results of the application of the principle of similarity to correlate the results of measurements of convection, showing that the observations of different workers could be closely harmonised in this way

Prof J W Cobb gave an account of the relations between the Institution of Gas Engineers and the University of Leeds extending back to 1906 The Institution lent encouragement to the establishment of a Fuel Department at the outset, and in 1910 endowed the chair in memory of the late Sir George Livesey Since that time there has been close co operation in the prosecution of investigations bearing on the problems of the industry This is one of the earliest examples of co operative industrial research in Great Britain, and the paper collated a large range of subjects which have been covered since that time On the teaching side, it was stated that for years the demand for suitable graduates has been in excess of the men coming forward H J H

Visitation of the Royal Observatory, Greenwich

THE annual visitation of the Observatory took place on June 7 The Astronomer Royal presented his report, which deals with the work of the Observatory during the year ended on May 10 The usual fundamental meridian work was carried on with the transit circle, the sun having been observed on 150 days, and the moon on 104 days The excess of the moon's longitude over its tabular value was 5 2″, the excess has been diminishing since 1924 by nearly ⅓″ per annum the corresponding excess for the sun, which was 1 7″ in 1926, has now fallen to 1 6″ The observation of stars in the zone 32° to 64° of declination will be completed this year The next star catalogue will cover the zones 0° to 24°, and 64° to 90°,

it is not now considered necessary to observe many stars fainter than magnitude 8 on the meridian, the positions of fainter stars are obtainable by photography with lenses of wide angle

Observations with the Cookson floating zenith telescope now cover a period of nineteen years, which is the period of the great lunar nutation term Dr J Jackson is discussing the observations, to deduce a new value for the coefficient of this term, it appears that the adopted value 9 210″ will not be altered by more than 0 002″ The Gerrish drive, installed last year on the 28 inch equatorial, has worked very well 300 binaries were observed during the year, of which 56 were separated by less than ½″

The determination of stellar parallaxes by photography with the Thompson equatorial has proceeded at an accelerated pace, 1508 parallax plates having been taken, and 651 plates measured

The determination of the 'colour temperatures' of stars has been continued with the 30 inch reflector The observation of 24 stars selected as standards has been completed, these are now available as a base to which other stars can be referred The absolute temperatures of the standards are now being found by comparison with an arc lamp, which in turn will be compared with a gas filled lamp already calibrated at Utrecht

The astrographic equatorial, which had been sent to Siam for the solar eclipse, was remounted in July Some renewals in the bearings and accessories were satisfactorily carried out by Messrs Grubb, Parsons and Co The Greenwich astrographic zone, decl 64° to 90°, is being re photographed for the determination of proper motions by comparison with the earlier plates, the motions of 14,500 stars between 64° and 72° have now been published

The sun was photographed on 270 days at Greenwich, plates taken at the Cape and Kodaikanal will render the record complete The spot activity is definitely on the wane, there were, however, large spots in November and December A spectrohelioscope has been lent to the Observatory by the Mount Wilson Observatory, it has been mounted in the south attic of the new building A survey of the sun's disc in H_α light is made daily, when weather permits Special attention is paid to the radial velocities of dark markings near sunspots

Spot numbers for the whole disc, and for the central zone, are supplied regularly to Zurich for incorporation in the bulletin that is issued there under the auspices of the I A U

The mean temperature of the year was 51 0°, which is 1 5° above the 75 year average, the extreme values were 90 5° on Aug 31, and 25 4° on Mar 20, both dates are unusually late for the extreme readings The rainfall was 25 43 inches, which is 1 19 in above the average The winter was a stormy one, and the mean daily air movement, 289 miles, is 5 miles above the average The highest daily value was 847 miles on Dec 7, the highest hourly value 62 miles on Jan 12, which also had the greatest pressure, 38 lb per sq ft

The following are the mean values of the magnetic elements for 1929, obtained at Abinger, Decl 12° 35 8′ W, Hor Force 0 18555 Vert Force 0 42918 Dip 66° 37 2′ It is noted in the report that a more precise instrument for determining the vertical force and dip was lent by the National Physical Laboratory, it revealed a small systematic error in the values given by the dip inductor, the error was 0 00010 in Vert Force, 0 3′ in Dip

The performance of the Shortt clocks continues to be satisfactory, in the sidereal clock No 3 an invar bob was substituted for the type metal one, the latter contained lead, and a certain amount of settling appears to have gone on, causing an increase of losing rate This increase still goes on with the new bob, but at only half the former rate

Rhythmic time signals from the Observatory are distributed by the wireless station at Rugby at 10 h and 18 h These, and the signals sent to the Post Office and the B B C, are controlled by the clock Shortt No 16

The following are the mean amounts by which the time signals from other stations are late on Greenwich Paris 0 044 sec Nauen 0 006 sec Annapolis (near Washington) 0 007 sec Bordeaux 0 035 sec These are after corrections for lag and time of travel have been applied

A C D CROMMELIN

An Early Letter from Darwin to Owen

THE letter printed below was bought at Sotheby's in March of this year for the Fitzwilliam Museum, Cambridge, by some friends of that institution It was written rather more than two months after Darwin's return in the *Beagle* The fossil vertebrates referred to in the letter were sent to the Royal College of Surgeons Darwin wrote to Owen, who was five years his senior, as a young man addressing a more experienced and older colleague later the two became friends and Owen visited Down in 1848 Twelve years later, in a letter to de Quatrefages, Darwin wrote "I have been atrociously abused by my religious countrymen, but as I live an independent life in the country, it does not in the least hurt me in any way, except indeed when the abuse comes from an old friend like Professor Owen, who abuses me and then advances the doctrine that all birds are probably descended from one parent" ("More Letters of Charles Darwin", vol 1, p 202) Reference is made to Darwin's attitude towards Owen in a note printed at the head of a letter to Hugh Falconer (1863) on page 226 of vol 2 of "More Letters"

Darwin settled at Cambridge on Dec 10, 1836 he was at first a guest in the home of the Henslows, and later went into lodgings at a house in Fitzwilliam Street, on which a tablet has been fixed The letter was written as from Christ's College, though he was presumably not actually in residence there

A C S

Decemb 19th (1836)

My dear Sir,

I have just written and will send it the same time with this, a letter to Sir Ant Carlisle I have done exactly as you recommended me I thought myself compelled to fix on the British Museum in preference to that of Paris because I was carried on board a King's Ship, and the public collection of the country certainly has claims on me If the collection had been made entirely at my own expense, that is on board a Merchant vessel, then I should not have hesitated in making a different choice I quite agree with you that the British Museum ought to make returns when it has the power I suppose you could not venture to propose another set for Paris Their value would be so much more in that collection than in the British Museum I ought to make up my mind to give my own set to Paris, but I confess I should be grieved to lose my trophies I should feel like a knight who had lost his armorial bearings If the Council should not choose to go to the expense necessary for making all the casts, it was suggested to me here, that the

College might pay the price of forming the casts, and the public bodies purchase the models, but I think you will agree with me, that if this can be avoided, it will be better With respect to great head of the Rodent, I certainly feel inclined to run the risk of taking a cast, because the models will be more generally useful, even in case the head itself should be injured or destroyed But I am sure after the kind and effectual manner with which you have entered on this affair I cannot do better than follow your advice I, at one time, began to think that the fossil bones would be as troublesome to me and as of little service as some other branches of my collection are likely to be But now I look back to the trouble I took in procuring them with great satisfaction I do assure you I feel very grateful to you for having given me such good assistance I have scarcely begun to unpack my cases, in the course of a week I shall have every thing open, and I already know of one very large bone (of a Mastodon ??) which I will forward to the College When separating the animals in spirits, I will put by any that I think will interest you And it will be a great pleasure to me if I chance to possess anything which will be of use to you in your number less investigations

Believe me, my dear Sir,

Your very truly obliged
CHAS DARWIN

Christ Coll
Cambridge

To Richard Owen, Esq^r
Royal College of Surgeons,
Lincoln's Inn Fields

Biochemical Studies of Spike Disease of Sandal

MR M SREENIVASAYA and Mr B N Sastri have continued their very detailed investigations into the spike disease of sandal (*Santalum album* L), and their latest results are to be found in the *Journal of the Indian Institute of Science*, vol 12A, Part 17, pp 233 to 252 (1929) Leaf juice from a sandal tree infected with the spike disease hydrolyses more soluble starch than does the corresponding healthy juice This is due to a higher concentration of the enzyme and to the presence of activators such as phosphates and amino acids The *p*H of spiked leaves is lower than that of healthy leaves, and approaches the optimum for diastatic activity More potato starch is, however, liquefied by the healthy leaf extract than by the diseased extract for equal weights of sugar produced, thus suggesting a qualitative difference between the two diastase extracts It should be remembered that Dr L C Coleman found that there was lower diastatic activity in spiked leaves than in healthy leaves, and therefore the results here reported might be interpreted as showing that the diastase content of diseased tissue fluctuates within the same limits as does that of healthy tissue

The chemical composition of leaf and stem tissue fluids has also been investigated The spike diseased leaf contains more nitrogen, maltose, and reducing sugars and less ash (particularly calcium) than the healthy leaf The stem fluids of spike diseased trees are richer in nitrogen, phosphorus, and calcium than those of healthy plants, and there is a steep gradient of calcium concentration between the stem and leaves

The seasonal variations in composition of healthy and partially spiked leaves of the sandal tree have been studied by Mr A V Varadaraja Iyengar (*Jour Ind Inst Sci*, vol 12A, Part 20, pp 295 305) Season was found to affect the chemical composition of the leaves of both healthy and spiked plants in the same manner The following relative differences were observable in all seasons—the diseased sap had less dissolved matter, less osmotic pressure, a greater electrical conductivity, more moisture, ash, and nitrogen contents, less calcium, and was more acid than healthy sap

These detailed studies on sandal spike from the Indian Institute of Science have considerable significance, for it has recently been shown by Mr M J Narasimhan (*Phytopathology*, 18, pp 815 817, 1928) that inclusion bodies similar to those which characterise certain virus diseases are present in leaf tissues of spiked plants This, along with the work of Dr L C Coleman on transmission, suggests that the malady is caused by a virus We have thus a mine of detailed information on the chemistry of a diseased host which we can use in the elucidation of the problem of the nature of a plant virus

University and Educational Intelligence

ABERYSTWYTH —Dr C D Forde formerly of the Department of Geography, University College London, has been appointed to succeed Prof H J Fleure in the chair of geography and anthropology at the University College of Wales, Aberystwyth Dr Forde has just returned from the University of California, where he held a fellowship from the Commonwealth Fund, and received the degree of doctor of philosophy for his researches among the Hopi Pueblo Indians of North Arizona

CAMBRIDGE —The following have been appointed members of the Committee for the Natural Sciences Tripos for the year 1930–31 Prof A Hutchinson (chairman), Prof T M Lowry, Mr H Thirkill Dr W H Mills Mr A Wood, Mr E Cunningham, Mr F T Brooks, Mr T C Nicholas, Mr J T Saunders Dr Dean, Sir Frederick Gowland Hopkins, Prof J Barcroft

The General Board recommends that a University demonstratorship in pharmacology be established in the Faculty of Medicine

Mr Stanley Baldwin was installed as Chancellor of the University on June 5 and in the course of his address announced that the gift from the Rockefeller Foundation had been made available through the completion of the collection of a sum which was made a condition of the grant The total sum required for the University Library and for research work was £1,179,000 The Rockefeller Foundation had promised £700,000 conditional on the balance being raised by the end of 1931 This balance has now been raised

Honorary degrees were conferred by Mr Baldwin after his installation on the following, among others Prof A Einstein, of Berlin, Prof Max Planck, of Berlin, Sir John Rose Bradford, president of the Royal College of Physicians, and Sir James Colquhoun Irvine, principal and vice chancellor of the University of St Andrews

LIVERPOOL —Among the honorary degrees conferred on June 5 were the following Doctor of Laws, Mr R L Mond, honorary secretary to the Davy-Faraday Research Laboratory of the Royal Institution, Doctor of Science, Prof G Barger, professor of chemistry in relation to medicine in the University of Edinburgh

LONDON —Applications are invited for the Graham Scholarship in Pathology, value £300 per annum, in the first instance for two years, founded under the

will of the late Dr Charles Graham to enable "a young man to continue his pathological researches and at the same time to secure his services to the School of Advanced Medical Studies connected with University College Hospital as a Teacher under the direction of the Professor of Pathology"

The latest date for the receipt of applications is June 17 They should be sent to the Principal, University of London, South Kensington, S W 7

OXFORD —The question of the destiny of the Radcliffe Observatory site and buildings has now come officially before the University in the form of a decree in Congregation By this it is proposed to accept the offer of Sir William Morris, the purchaser of the site from the Radcliffe Trustees, to vest the whole of the property in the hands of a body of trustees, in order that it may be used for the benefit of the Radcliffe Infirmary and the Medical School of the University The terms of the trust provide that the old observatory building shall be used for the purpose of medical teaching and research, and that the observer's house and garden shall be used as a residence for the director of the institute of research to be constituted in accordance with these terms

The report issued by the Curators of the Botanic Garden includes a list of noteworthy plants lately received, and mentions improvements in the labelling of trees shrubs, and plants

The Herbert Spencer Lecture, delivered by Sir Peter Chalmers Mitchell, was a vigorous defence of materialistic monism which, he said, so far from being discredited as a theory by recent advances in physical science, stands now in an even stronger position than in Spencer's day Not one of the forms of what is called vitalism can, in his opinion, stand the test of critical examination Progress in science must be achieved, as of old, by the way of experiment and observation

In a lecture recently delivered in Oxford, Miss Caton Thompson gave an interesting account of her exploration of the Great Zimbabwe and of other ruins in Rhodesia She dwelt upon the fact that no evidence of any kind exists to suggest that these remains are of other than Bantu origin, or that they owe any thing to outside influence The stratigraphical evidence which is now available from many sites in Rhodesia all points in the direction of Bantu as against Arab, Phœnician, or any other kind of foreign activity

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THE New York correspondent of the *Times* states that Mr Louis Bamberger, the retired head of Bamberger and Co, Newark, New Jersey, and his sister, Mrs Felix Fuld, have given £1,000,000 for the establishment in Newark or the vicinity of an institute for advanced study, exclusively for post graduate work and scientific research

AT a meeting at the Mansion House, London, on June 2, the Lord Mayor presiding, it was announced that a contract had been signed for the purchase of a freehold site in Bloomsbury for 'London House', the proposed hall of residence in London for British male students of European origin from the Dominions and Colonies and from Great Britain The object of the meeting was to launch an appeal for a fund of £250,000 to be administered by the Dominion Students' Hall Trust, for which an influential council of governors has been appointed, with Mr F C Goodenough, of Barclay's Bank, as chairman Towards this fund £130,000 has already been contributed The appeal was supported from the platform by Mr L S Amery, Mr H A L Fisher, Mr Stanley Bruce, Sir James Parr, Sir William Clark, Sir Drummond Chaplin, Lord Moynihan, and Mr F C Goodenough Special reference was made to the post graduate medical school to be established at Hammersmith 'London House', while closely associated with the University of London, will be an independent institution and the governing body includes representatives of the University, the Royal Colleges of Surgeons and Physicians, and other professional institutions The Corporation of the City of London and the Rhodes Trustees have each made a donation of £5000 to the fund The Lord Mayor read a letter from the Prime Minister strongly supporting the appeal "London House", he said, "appeals to common sense, to the spirit of hospitality, to the imagination Let us look ahead and see the young men of our race coming to London with their vigour and freshness of outlook, intermingling with us and each other, sharing in our heritage of learning and experience and tradition, and returning so equipped to wherever British energy and enterprise have set their homes"

THE Committee of Award for the Commonwealth Fund Fellowships has made appointments to 26 fellowships tenable by British graduates in American universities for the two years beginning September next, including the following Mr R W Adams (Belfast) to Massachusetts Institute of Technology, in electrical engineering, Mr J T Calvert (Oxford) to the Massachusetts Institute of Technology, in sanitary engineering, Miss I G M Campbell (St Andrews) to Cornell University, in organic chemistry, Miss R L Cohen (Cambridge) to Stanford University, in agricultural economics, Mr A G Emslie (Aberdeen) to Cornell University, in physics, Mr H Fisher (London) to the Massachusetts Institute of Technology, in civil engineering, Mr G V B Herford (Oxford and London) to the University of Minnesota, in zoology, Dr D W Hill (Bristol and Liverpool) to the University of Illinois, in biochemistry, Mr F L Hudson (Manchester) to the University of California in physical chemistry, Dr J Irving (St Andrews and Cambridge) to Harvard University, in geology, Mr T H Kelly (Birmingham) to Columbia University, in economics, Mr J E MacColl (Oxford) to the University of Chicago, in economics, Mr J E Meade (Oxford) to Stanford University, in economics, Mr A K Nuttall (Cambridge) to Stanford University, in electrical engineering, Dr R W B Pearse (London) to the California Institute of Technology, in physics, Mr R W Revans (London and Cambridge) to the University of Michigan, in physics, Mr W J Sartain (Cambridge) to Yale University, in economics, Mr W A Sinclair (Edinburgh and Oxford) to Harvard University, in philosophy, Mr S Steele (Cambridge) to Johns Hopkins University, in aero engineering, Mr William Wild (Leeds) to the University of California, in physical chemistry The following have been appointed to fellowships tenable by candidates from the British Dominions Mr N S Bayliss (Melbourne and Oxford) to the University of California, in chemistry, Mr W G K Duncan (Sydney and London) to the University of Chicago, in sociology, Mr P J Hogan (Dublin and London) to Iowa State University, in civil engineering, Mr S J Pretorius (Stellenbosch and London) to Cornell University, in economic statistics The following have been appointed to fellowships tenable by candidates holding appointments in Government service overseas Dr C M Tattam, of the Geological Survey of Nigeria, Mr C Vigne, of the Forestry Department, Gold Coast Colony, Capt R D Waghorn, of the Indian State Railways

Historic Natural Events

June 15, 1818 Avalanche Flood—An avalanche from the front of the glacier of Lépenaz blocked the outlet of the Lake Glière, raising its level 25 feet When the dam broke a mass of water estimated as one hundred million cubic feet in volume flooded the valley of Doron of Champigny, carrying away all the bridges but one

June 15, 1829 Hailstorm—At Cazorla, in the south east of Spain, hailstones fell in the form of blocks of ice, some of which had a circumference of 20 in and weighed as much as 4½ lb Great damage was done, houses being literally crushed beneath the bombardment of ice

June 15, 1896 Japanese Earthquake Sea-waves — A great earthquake occurred off the north eastern coast of Japan, its epicentre being 150 miles from land at a depth of 4000 fathoms (4½ miles) near the foot of the western slope of the Tuscaroora Deep The shock was slightly felt on land, but after a lapse of 21 minutes great sea waves, more than 60 feet in height, swept over the coast and caused the loss of 27,000 lives The sea waves were recorded at Honolulu (3591 miles) and Sausalito (San Francisco Bay, 4787 miles)

June 15, 1914 Severe Thunderstorm over Paris — On June 15, 1914, a severe thunderstorm occurred over Paris During the storm 2 1 in (54 mm) of rain fell, 1 6 in (41 mm) within twenty five minutes On only one other occasion has this been equalled The heavy rain caused the subsidence of several streets

June 16, 1819 Indian Earthquake—The great earthquake of Kutch, in the delta of the Indus, disturbed an area of more than 3 million sq miles A large tract of land, 2000 sq miles in area, subsided, and the sea, flowing in by the eastern mouth of the Indus, submerged the village of Sindree and converted the tract into a lagoon A short distance to the north, the previously level plain was raised as an elevated mound, 50 miles long and about 10 feet in height, running east and west or parallel to the line of subsidence

June 17, 1815 Thunderstorms—There were heavy thunderstorms in Belgium on June 17, which made the roads difficult for traffic As a result the movements of the French army, which were timed for the early morning of June 18, were delayed until nearly noon This loss of time may have affected the course of the battle of Waterloo

June 18, 1764 Thunderstorm in London—During a violent thunderstorm the steeples of St Bride's in London and the church at South Weald in Essex were both struck by lightning and much damaged At St Bride's the metal spindle carrying the vane was fixed into a stone, and the greatest damage was done at this junction, the stone being shattered into small pieces H M S *Ramillies*, lying at Chatham, was split and torn to pieces by the lightning at about the same time It is noted that the preceding weather had been very warm and dry, and that the damage was done before the rain began to fall The storm is of interest for the discussion which it provoked at the Royal Society, and because it helped to bring about the use of lightning conductors in Great Britain

June 18, 1907 Waterspout—A phenomenon variously described as a 'cloudburst' or 'waterspout' occurred near Blanchland on the eastern edge of the Durham Moors A dense column, shaped like two cones joined at their apices, approached very rapidly, with a noise like the engine of a heavy motor-car Near the village it burst, and an immense volume of water fell from it, flooding the whole countryside, while heavy rain and hail added to the damage Large stone walls were broken up and their contents scattered over the fields, while the roads were seriously damaged and in places entirely destroyed Eight sheep were killed by lightning, while others were washed away and drowned

June 19, 1566 Floods in Europe From June 19 onwards for a whole month there was serious flooding by the Rhine There were also great floods in the Danube, Drau, and Save In England, after a very rainy spring, the summer was dry and the autumn almost rainless

Societies and Academies

LONDON

Linnean Society, May 1—E B Worthington Vertical movements of fresh water macroplankton The changes in vertical distribution of Crustacea were examined over periods of twenty four hours or more in the Victoria Nyanza and in Lake Lucerne by means of a vertically hauled closing plankton net The movements of the plankton were traced from hour to hour and correlated with the amount of light and other physical conditions In L Lucerne, most species start their descent at dawn, and reach their lowest level (50 60 metres) before the sun attains its zenith Then a slow upward movement starts, accelerates at dusk, and continues for two or three hours after complete darkness There is a difference between the behaviour of young and old individuals of certain species The organisms appear to be under the influence of two forces (1) a negative geotropism, acting persistently from below and causing them to congregate in the upper layers, and (2) a negative heliotropism, acting intermittently from above and causing those species which are susceptible to light to descend during the day Most species are filter feeders, dependent on the nanno plankton, which is most abundant in the upper layers, it is suggested, therefore, that hunger is the ulterior reason why they should seek the upper layers—G P Bidder On the attitude of a Hexactinellid at the bottom of the sea, as compared with that assumed in museum jars and monographs Glass sponges have never been seen in the great depths which form their natural habitat, they are known only from specimens torn up from the bottom of the ocean The dermal tissue of sponges is sensitive to the movement of water over its surface If we assume that in growing sponges growth is more rapid on the side against which the current impinges, we can explain the anomalies of spoon like and fan like forms in the same species of Choniid or Axinellid sponges in which cup like forms are found, the cup like form showing a compassing tide and the fan a constant current A similar reaction in a sponge of fixedly tubular shape would cause the side of the tube towards the current to grow longer than the sheltered side, so that the sponge would bend until the axis of the tube lay down stream and all sides were acted upon equally—M Burton Glass sponges The scientific history of sponges can be resolved into three phases (1) prior to 1842, when opinion was divided whether they were plant or animal, (2) from 1842 until recent years, when they were regarded as animals, but their position was doubtful, (3), 1929, marked by Dr Bidder's proposal to revive the idea of treating them as a sub kingdom, the Parazoa This sub kingdom he divided into two phyla, the Nuda and the Gelatinosa, the former to include the Hexactinellida only, the latter the rest of the sponges This recognition of the great gulf between the Hexactinellida and other sponges, and between sponges and the rest of the animal kingdom, counteracts the tendency

to make too close a comparison between the Hexactinellida and other sponges, and it also lays stress on the undesirability of seeking to homologise the structure of sponges with that of the Metazoa

CAMBRIDGE

Philosophical Society, May 19 —Dr P A M Dirac (1) On the annihilation of electrons and protons On the basis of the relativity wave equation for the electron, a calculation is made of the probability per unit time of an electron jumping into a state of negative kinetic energy and emitting the surplus energy in the form of two light quanta If we assume that nearly all the negative energy states are occupied by electrons and that an unoccupied one is a proton, this probability gives the rate at which electrons and protons annihilate one another The calculated rate is much too large to be in agreement with observation —(2) Note on exchange phenomena in the Thomas atom The equations of the self consistent field with inclusion of exchange effects may be expressed in terms of a single total electron density function If we approximate to this density by considering it as a classical function of commuting co ordinates and momenta, we get the equations of the Thomas atom with an extra term representing the exchange effects

EDINBURGH

Royal Society, May 16 —**Georg Weigner** Base exchange The difficulties experienced by Way and other early investigators in explaining the mechanism of exchange processes are gradually being overcome by intensive study of reactions in colloid systems Cation exchange properties are attributed to micelles consisting of an ultramicron, an inner layer of anions, and an outer swarm of cations, only the ions of the outer swarm are exchangeable, and the extent of the reaction depends upon their hydration, valency, and the forces binding them to the inner layer For example, magnesium, on account of its greater hydration, is absorbed less readily than the other alkaline earths, but it is not so easily displaced, because it forms less soluble compounds with the hydroxyl ions of the inner layer The ultramicron of clays and permutites may contain silicic acid and aluminium hydroxide, within certain limits, the greater the proportion of the former the greater the cation exchange That is because there is a greater dissociation of cations from the silicic anions than from the hydroxyl ions attached to the aluminium Ionic exchange determines the potential and coagulation of the particles

PARIS

Academy of Sciences, April 28 —**Ernest Esclangon** The determination of the position and of the elements of a planet or distant comet Application to the Lowell celestial body —**Gabriel Bertrand and Mme M Rosenblatt** The proportion of potassium and sodium contained in plants which grow in brackish water or on the sea-coast The analysis of sixteen species of plants is given All the plants contained both potassium and sodium, with a general predominance, sometimes considerable, of potassium It is only in plants adapted to media rich in common salt that the ratio K/Na falls below unity —**A Th Schloesing and Désiré Leroux** The solvent action of carbonic acid with respect to phosphoric acid in agricultural soils —**André Blondel** Falls of electromotive force in triphase apparatus feeding unsymmetrical circuits —**Henri Villat and Maurice Roy** Concerning the problem of Saint Venant for the slit cylinder Reply to some remarks by A Mesnager —**S Finikoff** *W* congruences having along corresponding radii the same linear complex operator.—**Georges Bouligand** Certain classes of surface of three dimensional Euclidian space —**Henri Cartan** The exceptional values of a meromorph function in the whole plane —**Elie Cartan** The third fundamental theorem of Lie —**Marcel Dufour** The astigmatism of the pencil refracted by a spherical diopter —**P Swings** The resonance groups of the diatomic vapour of sulphur —**Maurice Piettre** The function of the non electrolytes in the stability of biological media If electrolytes play an important part in the equilibrium of organic liquids, this rôle is restrained within certain limits Lipides have a very remarkable influence the physico chemical mechanism of which is still unexplained —**M Paić** Study of the system HgO SO_3 H_2O A combination of analytical and X ray methods —**A Travers and Avenet** The estimation of the total cyanogen in effluents from coke ovens The essential point is treatment of the well-cooled solution with sodium peroxide before acidifying and distilling off the hydrocyanic acid —**Sébastien Sabetay** The optically active acidylhydrazides and their use for the separation into optical isomers of the racemic aldehydes and ketones —**J Bougault and Mlle L Popovici** The reduction of the semicarbazones and thiosemicarbazones of the α ketonic acids and of the sulphoxytriazines —**Raymond Chevallier** The permanent magnetisation of the Feroe basalts —**H L Parker** The polyembryonic development of *Macrocentrus gifuensis* —**Raymond Hovasse** Some new data on the cochineal insect, *Marchalina hellenica* —**Ugo Lumbroso** New researches on the etiology of trachoma The study of a germ, met with in Tunis, in its relations with the *Bacterium granulosum* of Noguchi

GENEVA

Society of Physics and Natural History, Mar 6 —**R Wavre** The force which, at earlier periods, tended to draw a continent to the equator The author gives an extremely simple formula for calculating the intensity of the force which causes a floating body, boat, iceberg, or continent to increase its distance from the pole This force is proportional to the square of the velocity with which the earth turns round its axis This velocity has been reduced in the course of geological epochs owing to the phenomenon of tides The force in question was much greater then than now —**G Tiercy** A formula giving the value of the colour index of a star This deals with the question of obtaining a new approximation of the solution of the problem, retaining terms the influence of which has hitherto been neglected in the calculation —**E Rod** Tables of the coefficients of the instrumental errors, in Mayer's formula, for the latitude of Geneva These new tables have been worked out for declinations from $-31°$ to $+80°$ The values are given for every degree from $-31°$ to $+30°$, every 30′ from $+30°$ to $+35°$, every 20′ from $+35°$ to $+69°$, and every 10′ from $+69°$ to $+80°$

Mar 20 —**L Duparc** An anorthose trachyte from Gambeila (Abyssinia) The author has collected in small volcanic cones a rock of a particular type, formed almost exclusively of microlites of anorthose The rock is very rich in alkali (nearly 15 per cent) —**J Briquet** The glochide trichomes of Helminthia The author shows that, contrary to that which has been recently proved for the glochide emergence of Crupina, the multiseries glochides of Helminthia are of purely epidermal origin, without vascular elements, and their hoods are formed uniquely by the curvature of the apical cells of the foot This puts the glochidate hairs, from the functional point of view, in relation with a mode of zoochore dissemination —**E Pittard** The coronal angle in the skulls of Bushmen, Hottentots, and Griquas The author has measured a series of skulls sent to the anthropological laboratory of the University of Geneva by the Cape Town Museum The values obtained compared with those of the

cephalic index indicate certain differences between the Hottentots and the Griquas —R Wavre The planetary stratifications The author gives a method for recognising whether a given family of surfaces can represent the stratification of a star in rotation This method dispenses with the calculation of the potential As a particular case, he arrives very simply at the theorems of Volterra and Dive on the impossibility of ellipsoidal stratifications —P Balavoine The luminosity of some colouring matters in ultra violet light If wool or silk dyed with auramine is submitted to ultra violet light, there is produced a strong yellow luminosity resembling phosphorescence Fluorescine and its derivatives present the same phenomena, but with less intensity

May 8 —J Carl Some observations on the relief of southern India In the course of a journey made during the winter of 1926–27, having for its principal object studies of the fauna, the author also made observations on the relief of the country He distinguishes three erosion cycles clearly visible on large scale maps His interpretations are in agreement with the evolution of relief of the island of Ceylon, described by F D Adams (*Canadian Journal of Research*, 1929)

PRAGUE

Czech (Bohemian) Academy of Sciences and Arts (Second class, Natural Science and Medicine), Feb 7 —L Borovansky Morphological changes in rats effected by strenuous work —J Charvat, A Gjurič and E Sedláčková The protein preparatory reflection —V Jarnik Some remarks on the Hausdorff measure —V Kladivo The determination of the relative intensity of gravity in Brno and Potsdam respectively —J Basta The mechanical theory of the solidification and hardening of cements and concrete It is concluded from experimental investigations that the chief physico chemical laws determine the hardening of concrete and rational formulæ are derived for practical use —R Nováček Biological factors in the formation of dolomites —F Wald Principles of the theory of chemical operations

Mar 14 —V Kladivo The determination of the relative intensity of gravity in Brno and Vienna respectively —R Brdička and M Pavlik Automatic registration of extinction curves of absorption spectra An apparatus has been constructed which makes possible the photography of continuous absorption spectra in solutions by using a Baly tube in which the thickness of the solution layer is automatically diminished logarithmically with time, whilst the dark slide is shifted with constant speed A complete characteristic extinction curve is thus obtained in about 20 min —J Hybl The heat of evaporation of liquids The constants a, b, c were evaluated for twelve polyatomic liquids in the following expression for the heat of evaporation $a(T_{cr} - T) - b(T_{cr} - T)^2 + c(T_{cr} - T)^3$, where T_{cr} is the critical temperature —A Vančura The function of factors outside the kidney in the origin of kidney and heart œdema —P Sillinger The vegetation of the limestone hills of Tematínské Kopce (Western Slovakia) On the dolomites of this small group near Pišt'any the pennonic associations predominate, though the Carpathian element is not absent Exhaustive description of all plant communities of this region is given —K Domin *Draba fladnizensis* Wulf, a new species for Czechoslovakia This alpine species was found in the Tatra of Biela. The author gives an analysis of the plant associations on the localities of this Draba, which represent an interesting glacial relic —F Prantl Revision of Czech Devonian Fenestellidæ —J Sobotka Generalisation of cyclographic and stereographic projection

Official Publications Received

BRITISH

Committee on Bird Sanctuaries in Royal Parks (England) Report for 1929 Pp 18 (London H M Stationery Office) 6*d* net

Smoke and Health a Lecture delivered at the Manchester College of Technology on November 15th 1929 By Dr J S Taylor Pp 12 (Manchester National Smoke Abatement Society) 2*d*

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1289 (Ae 438) The Determination of the Water Resistance of Seaplanes By H M Garner and I P Coombes (T 2872) Pp 10+1 plate 9*d* net. No 1293 (Ae 442) Exploration of the Flow near the Screw proposed for the N P L Compressed Air Tunnel By C N H Lock and A R. Collar (T 2895) Pp 10+6 plates 9*d* net (London H M Stationery Office)

Trinidad and Tobago Minutes and Proceedings of the Froghopper Investigation Committee Part 18 Pp. 80 (Trinidad Government Printing Office Port of Spain)

Cambridge University Agricultural Society Magazine 1930 Pp. 78. (Cambridge W Heffer and Sons, Ltd) 2*s* 6*d*

The Welsh Journal of Agriculture the Journal of the Welsh Agricultural Education Conference Vol 6, January Pp. 367 (Cardiff University of Wales Press Board) 2*s* 6*d*

British Science Guild The Annual Report of the Council of Management 1929–30 presented at the General Meeting of Members held at the Offices of the Guild on Thursday 5th June 1930, at 4 30 P M Pp 14 (London) 1*s*

Engineering Training at the Works of W H Allen, Sons & Co Ltd Bedford, England Pp. 30+11 plates (Bedford)

Proceedings of the Royal Irish Academy Vol 39, Section B No 16 Some Geological Observations on the Origin of the Irish Fauna and Flora By Prof J Kaye Charlesworth Pp 358–390 (Dublin Hodges, Figgis and Co London Williams and Norgate, Ltd) 1*s*

Air Ministry Aeronautical Research Committee Reports and Memoranda. No 1285 (M 66) Mechanical Properties of Pure Magnesium and certain Magnesium Alloys in the Wrought Condition (continued) Mechanical Properties of Electron Alloy By H J Tapsell, S L Archbutt and Dr J W Jenkin (A 30) Pp 9+3 plates 9*d* net. No 1275 (Ae 421) The Interference of a Wind Tunnel on a Symmetrical Body By C N H Lock (T 2842) Pp 20+5 plates 1*s* net No 1281 (Ae 427) 'Cornering' at High Speeds By W C Jennings (T 2862) Pp. 9+7 plates 9*d* net. No 1284 (Ae 434) Pressure Plotting a Streamline Body with Tractor Airscrew Running Part 2 Airscrew in Rear Position By C N H Lock and F C Johansen (T 2835) Pp 17+9 plates 1*s* net No 1291 (Ae 440) Some Generalised Curves for the Accelerated Motion of an Aeroplane By H Glauert. (T 2888) Pp 11+6 plates 9*d*. net No. 1295 (Ae 444) Maximum Lift Coefficient of 'Starling' with Clark YH Wings By R. P Alston (T 2886) Pp 2+2 plates 3*d*. net. No 1301 (Ae 485) Experimental Comparison between a Series of Turns of Different Diameter on a Gloster IV Seaplane By J K Hardy (T 2871 and a.) Pp 6+4 plates 6*d* net. (London H M Stationery Office)

FOREIGN

U S Department of Commerce Bureau of Standards Bureau of Standards Journal of Research Vol. 4 No 5, May Pp 601 735. (Washington, D C Government Printing Office) 40 cents

Bernice P Bishop Museum Bulletin 67 Hawaiian Marine Algae By Marie C Neal Pp 84 2 dollars Bulletin 68 Geology of the Marquesas Islands By Lawrence John Chubb Pp 71+8 plates 2 dollars Bulletin 69 Marquesan Legends By E S Craighill Handy (Bayard Dominick Expedition, Publication No 18) Pp 138+1 plate 2 dollars Bulletin 70 Ethnology of Tuhuai By Robert T Aitken (Bayard Dominick Expedition, Publication No 19) Pp iv+169+18 plates 2 dollars Bulletin 71 The Geology of Kauai and Niihau By Norman E A Hinds. Pp 103+12 plates 2 dollars Bulletin 72 Geology of Rarotonga and Atiu By Patrick Marshall Pp 75+5 plates 1 dollar Bulletin 73 Remarks on Pacific Fishes By Victor Pietschmann Pp 24+4 plates Memoir, Vol 11, No 2 Growth of Children in Hawaii based on Observations by Louis R Sullivan By Clark Wissler (Bayard Dominick Expedition, Publication No 17) Pp 151 Memoir Vol 11, No 3 Dental Morphology and Pathology of Prehistoric Guam By R W Leigh Pp 19+8 plates 1 dollar (Honolulu)

Wisconsin Geological and Natural History Survey Bulletin No 46 Mineral Lands of part of Northwestern Wisconsin By W O Hotchkiss and E T Bean, assisted by H R Aldrich (Economic Series No 21) Pp xiii+212 Bulletin 71 The Geology of the Gogebic Iron Range of Wisconsin By H. R. Aldrich (Economic Series No. 24) Pp x+279+16 plates (Madison Wis)

Proceedings of the United States National Museum Vol 77, Art. 8 Synonymical and Descriptive Notes on Parasitic Hymenoptera. By A. B Gahan (No. 2831) Pp 12 Vol 77, Art. 9 Three new Genera and five new Species of Parasitic Crustacea. By H F Nierstrasz and G A Brender à Brandis. (No 2832) Pp 9 (Washington, D C Government Printing Office.)

Meddelande från Lunds Astronomiska Observatorium Ser 2, Nr 55 Statistical Investigation of the Coordinates, Magnitudes and Proper Motions in W Gyllenberg's 'Katalog von 11800 Sternen der Zone +35 bis +40 ag Lund By Sture Holm Pp 88 (Lund C W K Gleerup Leipzig Otto Harrassowitz.)

Southwest Museum Papers No 3 The Tragedy of the Blackfoot. By Walter McClintock Pp. 53. (Los Angeles) 50 cents

U S. Department of Commerce Coast and Geodetic Survey Serial No. 166 Directions for Magnetic Measurements By Daniel L. Hazard Third edition. Pp. vi+129+8 plates (Washington, D C Government Printing Office) 30 cents.

The Memoirs of the Imperial Marine Observatory, Kobe, Japan Vol 2, No 4 On the Mean Atmospheric Pressure Cloudiness and Sea Surface Temperature of the North Pacific Ocean By K Tsukuda. Pp 163 202+39 plates. (Kobe.)

Memoirs of the College of Science, Kyoto Imperial University Series B, Vol 5 No 1 (Articles 1 4), March Pp 88+4 plates Series B Vol 5, No 2 (Articles 5-11), March Pp 89 245+plates 5 17 (Tokyo and Kyoto Maruzen Co, Ltd)

U S Department of Commerce Bureau of Standards Research Paper No. 168 Reduction of Data on Mixture of Color Stimuli By Deane B Judd Pp 515 548 (Washington, D C Government Printing Office) 10 cents

Bulletin of the School of Mines and Metallurgy University of Missouri Technical Series, Vol 11, No 1 The Scientific Fundamentals of Gravity Concentration By Prof Josef Finkey Translated into German from the Hungarian by Prof Johann Pocsubay Translated from the German by C O Anderson and M H Griffiths Pp 295 (Rolla, Mo) 1 dollar

CATALOGUE

Notes on the Hardness Testing of Metals Pp. 16. (London Wild Barfield Electric Furnaces, Ltd)

Diary of Societies

FRIDAY, JUNE 13

ROYAL ASTRONOMICAL SOCIETY at 5

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (Annual General Meeting) at 5 —T Thomas An Experiment in Keratoplasty

PHYSICAL SOCIETY (at Imperial College of Science), at 5 —E J Williams (a) The Induction of Electromotive Forces in a Moving Liquid by a Magnetic Field, and their Application to the Investigation of the Flow of Liquids (b) The Motion of a Liquid in an Enclosed Space —Prof E V Appleton Wireless Methods of Investigating the Electrical Structure of the Upper Atmosphere – Prof C R Darling A Simple Method of Showing the Modes of Vibration of a Wire —Demonstration by Dr H R Lang on A Modified Callendar Recorder for the Automatic Control of a High Temperature Oil Bath

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society) at 6 —L R Cox Description of a New *Vexillum* from the Pleistocene of the Farsan Islands (Red Sea) —Dr B Prashad Observation on the *Trochus* and *Turbo* Fisheries of the Andaman Islands

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Prof H Clay Unemployment

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB —N Ashbridge The History of Broadcasting in this Country

SATURDAY JUNE 14

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South Eastern District Meeting) (at Richmond and Barnes) (at Town Hall Richmond), at 12.

BIOCHEMICAL SOCIETY (in Department of Biochemistry, Oxford) at 2 30 —G F Marrian Observations on the Chemical Nature of Crystalline Œstrin —C W Carter Observations on the Curative Factor for Heartblock in Pigeons —E Walker The Alleged Presence of Bile Salts in Normal Blood —H J Phelps (a) Further Observations on the Mechanism of Adsorption of Weak Electrolytes by Charcoal (b) Adsorption by Fuller's Earth —J R P O Brien and G L Peskett On the Concentration of Bios —C W Carter H W Kinnersley, and R A Peters Factors Necessary for Maintenance Nutrition in Pigeons —H W Kinnersley and R A Peters Some Improvements in the Use of Phosphotungstic Acid in the Purification of Vitamin B_1 —H Chick and A M Copping (a) The Stability of Vitamin B_2 to Heat and Alkali, (b) A Search for Vitamin B_3 in Yeast Extracts —L F Hewitt Oxidation reduction Potentials of Cultures of *C diphtheriæ* and of *Staphylococcus aureus* —R. A. McCance and K Madders The Comparative Rates of Absorption of Sugars from the Human Intestine —F Dickens and F Šimer The Respiratory Quotient of Animal Tissues —B C J G Knight (a) The Oxidation reduction Potential of Sterile Broth (b) A Method of Poising the Oxidation reduction Potential of Bacteriological Culture Media —E C Dodds A Greenwood H Allan, and E J Gallimore Observations on the Properties and Physiological Action of Comb growth Promoting Substances (Testicular Hormone). —J A Cranston Denitrification and Bacterial Growth Phases —F K Herbert and M C Bourne The Non Sugar Substances of Human Blood in Anæmia and Polycythæmia. —H J Page and A W Greenhill The Relation Between the Nitrogen and the Phosphorus contents of Grass —*Demonstrations* —V B Reader Third Vitamin B Factor in Rat Nutrition —R. B Fisher Blood Pressure of Avitaminous Pigeons

MONDAY, JUNE 16

ROYAL SOCIETY, EDINBURGH at 4 30 —Dr G C Simpson The Climate during the Pleistocene Period

VICTORIA INSTITUTE (at Central Buildings, Westminster) at 4 30 —Sir Ambrose Fleming Creation and Modern Cosmogony (Presidential Address).

TUESDAY, JUNE 17

ROYAL SOCIETY OF MEDICINE, at 5 30 —General Meeting

LONDON NATURAL HISTORY SOCIETY (at Winchester House, E C), at 6 30 —R W Pethen A Londoner's Memories of Bird Life

WEDNESDAY, JUNE 18

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South Western District Meeting) (at Town Hall, Torquay), at 2

ROYAL METEOROLOGICAL SOCIETY, at 5 —Dr C E P Brooks and S. T A Mirrlees Irregularities in the Annual Variation of Temperature in London —Dr C E P Brooks The Climate of the First Half of the Eighteenth Century

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 6 15 —Annual General Meeting

FOLK LORE SOCIETY (at University College), at 8 —M Gaster Roumanian Contes Devota.

THURSDAY, JUNE 19

ROYAL SOCIETY at 4 30 —*Papers probably to be read* —Prof H R Robinson and C L Young New Results of the Magnetic Spectroscopy of X Ray Electrons —Dr F C Toy and G B Harrison Photo Conductance Phenomena in the Silver Halides and Latent Photographic Image —C H M Jenkins and M L V Gayler The Optical Determination of High Metallurgical Temperatures The Melting Point of Iron

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5 —D P Dalzell Note on Automorphic Functions —T Estermann On the Representations of a Number as the Sum of Two Numbers not divisible by k th Powers —C J A Evelyn On the Frequency of Certain Numbers —B Kuttner and S W P Steen Divisor Functions The Fourier divisor Integral Theorem —P M Owen A Generalisation of Hilbert's Double Series Theorem —R E A C Paley Note on Power Series —H S Ruse Normal Covariant Derivatives.—J A Todd On Questions of Reality for Certain Geometrical Loci —E M Wright The Bernstein Approximation Polynomials in the Complex Plane

ROYAL SOCIETY OF MEDICINE (Dermatology Section) at 5

CHEMICAL SOCIETY, at 8 —N V Sidgwick and L E Sutton The Constitution of Some Organic Derivatives of Thallium —F G Mann The Constitution of Complex Metallic Salts —Miss M S Leslie and E E Turner The Optical Resolution of 2 4-dinitro 2 Methyldiphenyl 6 carboxylic Acid —Miss D L Fox and E E Turner The Scission of Diaryl Ethers and Related Compounds by Means of Piperidine Part V The Nitration of Methyl Dimethyl, and Polyhalogeno derivatives of Diphenyl Ether —D L Hammick R. G A New, N V Sidgwick, and L E Sutton Structure of Isonitriles and Compounds of Divalent Carbon

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at 11 Chandos Street W 1) (Annual General Meeting) at 8 15 —Dr N H Fairley Sprue Its Applied Pathology, Bio Chemistry, and Treatment.

FRIDAY, JUNE 20

ROYAL SOCIETY OF MEDICINE (Laryngology Section) (Summer Meeting) Morning and Afternoon

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section) at 8 —A J Wrigley Puerperal Infection by the Pathogenic Anaerobic Bacteria

ASSOCIATION OF ECONOMIC BIOLOGISTS

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South Midland District Meeting) (at Harpenden).

SATURDAY, JUNE 21

NORTH OF ENGLAND INSTITUTE OF MINING AND METALLURGY (Newcastle upon Tyne) at 2 30

PHYSIOLOGICAL SOCIETY (at University College).—Prof L Lapicque and others Discussion on The Time Relations of Excitation and their Significance in Central Nervous Phenomena

ROYAL SOCIETY OF MEDICINE (Disease in Children Section) (at Norwich)

CONGRESSES

JUNE 16 TO 25

WORLD POWER CONFERENCE (at Berlin).

JUNE 21 TO 28

ROYAL SANITARY INSTITUTE (at Margate

Monday, June 23, at 8 —Lord Cornwallis Inaugural Address

Tuesday June 24, at 10 A M —Meetings of Sections and Conferences
A —Preventive Medicine
I —Representatives of Sanitary Authorities
V —Engineers and Surveyors
VI —Sanitary Inspectors
VII —Health Visitors (including Personal and Domestic Hygiene)
At 8 P M —Dr O C Bradley Diseases of Domestic Animals from the Human Angle (Lecture).

Wednesday, June 25, at 10 A.M —Meetings of Sections and Conferences
A —Preventive Medicine
B —Engineering and Architecture
D —Hygiene of Food
VI —Sanitary Inspectors
VII —Health Visitors (including Personal and Domestic Hygiene)

Thursday June 26, at 10 A.M —Meetings of Sections and Conferences
B —Engineering and Architecture
C —Maternity and Child Welfare (including School Hygiene).
F —Veterinary Hygiene
IV —Medical Officers of Health

Friday June 27, at 10 A M —Meetings of Sections and Conferences
C —Maternity and Child Welfare (including School Hygiene)
E —Hygiene in Industry
F —Veterinary Hygiene
II —Representatives of Port Sanitary Authorities
III —National Health Insurance Services

JUNE 22 TO 28

INTERNATIONAL CONGRESS OF MINING, METALLURGY, AND APPLIED GEOLOGY (at Liège) —In three sections (*A*) Mining, including Reconnaissance and Preliminary Work, Modern Methods of Working Coal Mines, Metalliferous Deposits and Quarries Generation and Utilisation of Energy Extraction Ventilation (Gas and Dust), and Mechanical Treatment of Ores and Coal (*B*) Metallurgy, dealing with Blast furnace Practice Steel and Ferrous Alloys, Foundry Work, Non ferrous Alloys and Fuels, (*C*) Applied Geology, covering Metals, Fuels, Hydrology, and Geophysical Prospecting.

SUMMER MEETING

JUNE 21 TO 28.

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in Holland).

SATURDAY, JUNE 21 1930

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Recruitment in the Colonial Services

A SHORT time ago a Committee was appointed under the chairmanship of Sir Warren Fisher to report on the System of Appointment in the Colonial Office and the Colonial Services its report which has been recently issued merits careful consideration In an opening section attention is directed to the extraordinary diversity of the territories administered by the Colonial Office covering an area of two million square miles practically all within the tropics with a population of nearly fifty millions Although often alluded to as the Colonial Service in effect there is no such thing as the Colonial Secretary has to deal with the affairs of more than fifty distinct governments ruling territories in size from as large as Central Europe down to remote island groups conditions of life material equipment and economic factors being entirely dissimilar

Recruitment to fill the government posts in these diverse governments has developed in the past in a haphazard fashion under varying conditions depending more on the ideas of a local governor for the time being than upon those of the authorities in Great Britain Since the Armistice matters have greatly improved and the number of posts has increased In 1909 the appointments made by the Colonial Office numbered 657 in 1929 they rose to 1076 and this in spite of the fact that many classes of appointments which were normally filled from Great Britain twenty years ago are now staffed locally But the Committee insists on the fact that this is not merely a matter of numbers Modern conditions demand also a generally higher standard of personal educational and professional qualifications and in addition the employment of men with scientific and special attainments of a kind not previously to be found in the Colonial Service It is the Committee s recommendations on this latter part of the problem which it is proposed to consider here

It will be necessary however to summarise briefly the excellent exposition given in the Report of the present system of appointment to the various Colonial Services (it is not proposed to dwell on the internal administration of the Office at home) and the recommendations made for its improvement Apart from local recruitment the selection of home candidates for employment in the Colonial Services is made in four chief ways (*a*) The Civil Service Commissioners in London hold periodical examinations for the selection of candidates for Eastern Cadetships (administrative appointments in Ceylon,

Malaya, Hong-Kong, etc), for the Ceylon police and for the post and telegraph services in Nigeria and the Gold Coast, (b) the Crown Agents to the Colonies select and appoint on behalf of Government candidates for technical posts, such as railways, public works, and so on, the selected men serving for a term of years, (c) the Private Secretary (Appointments) to the Secretary of State, aided by a strong staff, selects and recommends to the Secretary of State outside candidates for a first appointment in the Services, (d) other departments of the Home Government are asked, where necessary, to select from their staffs men with the desired qualifications to fill certain appointments overseas These departments are the War Office, Post Office, Customs and Education, Home Office and Air Ministry

It will be evident from the above résumé how varied have been the methods which have grown up with the object of securing quantity, quality, and variety of the staff required to carry on the great area administered from the Colonial Office

We are here concerned with the great variety of appointments, by far the larger number annually, the selection for which is carried out, and, as the Committee emphatically emphasises, admirably carried out, by the Private Secretary (Appointments) and his staff The Private Secretary and staff have always been able to obtain the advice and assistance of specialist advisers, both from the Colonial Office and the universities and from men of eminence in various professions, and lastly from senior Colonial officials on leave or recently retired The Committee places on record that the selection of candidates has at all times been undertaken with the greatest care and that the Colonial Governors have expressed entire approval of the type sent out The Committee is also at pains to show that the idea, which has prevailed in some quarters, that Oxford and Cambridge have been specially favoured in this selection is not borne out by facts The bulk of the appointments in administration have gone, for various demonstrable reasons, to these two universities, but London and the Scottish universities have provided the largest number of men for appointments in medicine and scientific departments, Edinburgh being specially mentioned as "the principal source" for forestry

Whilst fully acknowledging the successful manner in which the selection of candidates is carried out, the Committee considers it undesirable that it should continue to be performed by a staff of private secretaries to the Secretary of State It recommends that this staff should cease to be in the position of private secretaries and that the appointments branch should be incorporated as a permanent part of the Personnel Division of the Colonial Office In addition, it is recommended that a Colonial Service Appointment Branch, consisting of a chairman and two members nominated by the Civil Service Commissioners, should be set up as a standing independent branch for the final selection of candidates whose names are put forward by the appointments branch, and that the names of those selected be then submitted to the Secretary of State, on whose authority the appointments will be made It is also suggested that the promotions branch should be reorganised on a smaller scale and be a section of the Personnel Division There can be little doubt that these are excellent suggestions, and if put into effect they will greatly strengthen the hands both of selectors for first appointments and also of those dealing with that important question of promotion On the able recommendations of the Committee on the latter question space will not permit further digression but in the future interest of the Service they merit careful consideration

One other recommendation of the Committee requires mention before the scientific services are considered The question of the unification of the Colonial Service is discussed The Committee points to the hardships of officers on small cadres in the smaller dependencies, and admits all the objections which have been put forward—differences of salary, leave, pension, climate, customs and language of the people, and so forth, it recognises the reluctance of Governors and others to any change After a consideration of all the objections, the Committee remains convinced of the importance of unification and recommends that a single Colonial Service should be formed and that, within this larger whole, unified special services should be organised, such as agriculture, forests, medicine, education, and so forth As the Committee correctly points out, this issue is of the very first importance "Much of the information on which it rests cannot be present in the minds of Governors or their advisers overseas, since it relates particularly to questions of home recruitment and to the difficulties of individual Colonies"

The question of the technical and specialist research officers remains to be considered The Committee states that

"many of the officers appointed to scientific and technical services such as agriculture, forestry, veterinary, medical, and so forth, are qualified to undertake research work of a fundamental character, and some officers are appointed in the first instance

for the specific purpose of carrying out research work on urgent problems confronting a particular service In the ordinary course, however, an officer appointed to the agricultural service with special knowledge of plant diseases or insect pests, would rank for promotion in the higher grades in that service along with officers engaged in more general and less systematised duties, and would not necessarily confine himself to work of a specialised character throughout his service "

The statement that "many" of the officers appointed to the above services "are qualified to undertake research work of a fundamental character" would, for some of the services, scarcely be admitted at the universities Twenty per cent would probably be too high a percentage Experience has also shown that a young officer, on first appointment, should have a few years of executive work *before* being detailed for research This will prevent his making recommendations, when he takes up research, which the executive officer knows to be impracticable But this type of research officer, as the Committee points out, belongs to a definite service, will go up the grades of that service, will not necessarily confine himself to research all his service, and has a chance of securing the prizes of his own service His social position is also assured as a member of a service

The other type of research officer is perhaps of even greater importance—the whole time specialist As the Committee must have realised, this type has so far received scant attention His value is not called in question He is in demand The universities could say in how great demand They are aware that Government has now to compete in this market in some directions with the wide awake commercial people These specialist research officers are selected on the understanding that their whole service will be devoted to their particular line of research It is contemplated that their work will be of such a character that any results they may obtain will be applicable in many parts of the Colonial Empire Some of them may find it practicable to pursue their investigations in one particular research institution Others may find it necessary to conduct their researches in different parts of the Empire, attached either to a research station or to a scientific department In the normal course of things it is neither to be expected nor would it be desirable that their advancement should be conditioned by the occurrence of vacancies in the higher ranks of services other than their own. The Committee states that "it does not follow that such a service should be graded like other colonial services, for each individual in it must determine his own line of research in his particular sphere of work" In this connexion the Committee says

"In our opinion Research Officers should be encouraged by means of special inducements in the way of salaries and other terms of service to continue their long range investigations These terms should, in our opinion, be at least equal to those which they would be likely to obtain if they were prepared to abandon purely research work for more general duties"

Clearly there are considerations other than salaries to be taken into account in dealing with the research officers, and we should have preferred the Committee to have been more specific in its references to this class It would be disastrous for recruitment if the research officer were to remain 'no man's child', which would mean that he would not enjoy the social position which attaches to the services in the Empire circles overseas (and is of importance out there) The man may not care about this, but when he marries his wife will, and Government will lose a good man An example may be quoted Soon after the formation of the Agricultural and Forestry Research Institutes at Pusa and Dehra Dun, India, by Lord Curzon, a representative from each centre met by chance and discussed prospects In reply to some remark, the Pusa man ejaculated, 'Yes, your position is very different You belong to a Service We at Pusa do not" Dehra Dun was staffed from the Indian Forest Service The Pusa specialist returned home shortly afterwards and was a great loss That conversation took place more than twenty years ago!

A possible way out of this difficulty, it may be suggested, would appear to be to appoint each specialist research officer (for example, of the type serving in Malaya and Tanganyika) to one or other of the scientific or technical services (to which his investigations most nearly correlate) and then second him for research work on the understanding that his service would be spent on such work much as Royal Engineer and Military Medical officers are seconded for civil duty and remain seconded for the rest of their service High salaries, higher than the Colonial Office could afford to offer, will not tempt, or if tempted retain, the right stamp of man unless the social conditions of life are assimilated to those of the Services Incorporated in a Service, seconded with staff pay as specialised research officers, would, it is believed, remove the existing disabilities and secure in increasing numbers the type desired for this increasingly important work The Committee thus alludes to this work

"On the economic side we have to bring to bear the latest results of scientific research on the development of wealth, which is important, not only to the Colonies themselves but also to the Empire and the World Most of the greater problems of the Colonies to day are problems of Applied Science"

Possibly, however, the Committee wishes the research service to be a separate entity, under the general administrative control and supervision and responsible alone to an officer at the Colonial Office, linked through him with the various Imperial Bureaux which have recently been established, and through them with the British Dominions This is the underlying assumption in the various reports on colonial research to which the Committee refers, and particularly that of the sub-committee which reported to the Colonial Office Conference of 1927 on the possibilities of the creation of a Colonial Scientific and Research Service, available for the requirements of the whole Colonial Empire, in other words, the creation of an Imperial Service, financed out of an Imperial fund, to replace a number of water tight provincial services which have too long been dependent on individual Colonial governments, most of which have hitherto given little indication of their appreciation of the value of long range research

How Fire Became Known

Myths of the Origin of Fire an Essay By Sir James George Frazer Pp vii + 238 (London Macmillan and Co, Ltd, 1930) 12*s* 6*d* net

A NEW book by Sir James Frazer is assured of a cordial welcome, both on account of the exhaustive compilation of material which is rendered easily accessible to readers, and by reason of the charming literary style in which the collected data are placed on record and discussed The problems which are suggested by the mass of facts brought together and collated are without question intriguing In the present instance Sir James has set himself the task of collecting together for comparative study the various myths and legends which serve to explain to the primitive mind the way in which fire became known to mortals, and how, later, a knowledge was acquired of the means of producing fire at will Man, without doubt, was acquainted with and made use of fire, as kindled by natural processes, long prior to his discovery of the fact that it was possible to *make* fire by artificial means whenever occasion demanded Sir James even suggests a phase when man was "ignorant of the use or even of the existence of fire", and discusses the problem in terms of three successive phases, (1) the Fireless Age, (2) the Age of Fire Used, (3) the Age of Fire Kindled—phases which appear to be suggested by a study of the beliefs in regard to the origin of fire While the latter two phases are readily acceptable, as coming within the period of early human culture-development, it is less easy to imagine even the most primitive members of the genus *Homo* having been entirely unacquainted with fire as a phenomenon in Nature There is no evidence to prove that Nature did not cultivate the incendiary habit until man was already specialised as Man and had become differentiated from the rest of the animal kingdom His forerunners must already have experienced Nature kindled fire and must have learned to respect, or at any rate fear it It seems very unlikely that even proto man could have completely lacked such experiences, and it becomes difficult to credit a human phase involving complete ignorance of fire

In nearly all the myths of the origin of fire as an accessory to human culture, the supernatural plays an important part, and the pre scientific attempts of primitive minds to interpret the phenomenon of fire naturally do not show any inkling of its true nature In a strikingly large number of the legends, fire is reputed to have been stolen for man's use, usually from some supernal possessor, and, similarly, knowledge of the art of *making* fire has been very widely believed to have been obtained by trickery So wide spread among primitive peoples is this belief in the original theft of fire, that it appears highly probable that the Promethean myth of the ancient Greeks, with its closely similar record of the purloining of fire from Zeus, or from Hephæstus, was inherited as a traditional story handed down from a remote past, undergoing variation in detail to adapt it to local environmental and culture conditions It appears far more probable that this fire legend of Prometheus was a slightly modified descendant from an ancient and widely diffused folk tale, than that in it we see the prototype of a myth which spread from a centre of advanced culture and became disseminated among a vast number of heterogeneous and widely separated peoples of low culture

Prometheus, according to the legend, carried the fire which he had stolen ἐν κοίλῳ νάρθηκι, and, as Sir James says (p 195), the *narthex* "is commonly identified with the giant fennel " He expresses doubt as to Theodore Bent's suggestion that the *narthex* was a reed inside which the smouldering tinder was carried "to prevent its being blown out" ("Cyclades", p 365) The reason given for this

practice is questionable, since smouldering pith and other tinder substances burn more freely when blown upon, and it is probable that the protection would be against too rapid consumption of the tinder rather than against extinction of the spark. But there is some support for the theory that the *narthex* was a reed tube used to contain the tinder, since at the present day the custom obtains, in Manchuria, for example, of igniting a piece of pith and of carrying it smouldering in a tube of reed or bamboo. This at least gives some plausibility to the suggestion that the legendary Greek fire thief carried his ignited piece of fennel pith in a protecting sheath of reed. As a means of elucidating this academic point, it would be interesting to ascertain definitely the nature of the plant which is called *ναρθηκα* to this day by the inhabitants of Lesbos. Is it the giant fennel, or is it a reed, as stated by Bent?

In addition to the intrinsic interest of a nearly exhaustive *corpus* of myths detailing the varied ideas of various peoples all the world over, as to how the use and, later, the making of fire were discovered by man, there is the important bearing which the collation of such a mass of material has upon the wider ethnological problems. To the tracers of culture affinities and culture diffusion the data collected and presented in so masterly a manner, with the wealth of references to sources of information, will prove a valuable mine. Sir James Frazer has, indeed, by launching this new addition to his already powerful fleet of 'classics', increased materially the indebtedness of all those who study the problems of human culture.

HENRY BALFOUR.

Preparing Estimates for Ships

The Design of Merchant Ships and Cost Estimating: a Treatise on Ship Design and Cost Estimating, giving up to date Methods of arriving at Correct Proportions, Form and Power to attain Minimum Capital Cost with Maximum Service Efficiency. By Alexander Kari. Second edition enlarged. Pp. xiv + 307. (London: Crosby Lockwood and Son, 1930.) 36s. net.

THE designing, constructing, and fitting out of a ship may be compared with the planning, building, and furnishing of a great hotel which, when complete, must be ready in all respects for the reception of both guests and staff. In both cases there are somewhat similar preliminary investigations to be made and equally elaborate calculations as to size, accommodation, materials, and cost, while at every turn strict attention must be paid to official regulations. How elaborate these calculations are in the case of ships is well shown in this book of Mr. Kari's on "The Design of Merchant Ships and Cost Estimating."

Ships not only differ in size, form, and speed, but also there are many special types of vessels all of which demand separate consideration. Passenger vessels, cargo vessels, colliers, grain carriers, oil tankers, refrigerated ships, ice breakers, cable laying ships, dredgers, and tugs are examples of merchant ships built for special purposes, the designers of which must not only have a firm grasp of the principles underlying all naval construction but also a wide knowledge of the dimensions, performances, machinery, and fittings of vessels already on service. The collection of the data relating to the latter is one of the tasks of every draughtsman and shipbuilder, and the possession of such data is regarded as a valuable asset for the preparation of estimates. It is with this practical side of the subject that Mr. Kari has mainly dealt.

Commencing with a discussion of the choice of the type of hull to meet the shipowners' requirements, chapters are devoted to the determinations of a ship's dimensions, freeboard calculations, and to the general arrangements in cargo and passenger ships, the spacing of water tight bulkheads, and to the various regulations of the British, French, Norwegian, German, and Italian authorities. The general design of the ship having been determined, the detailed estimates of weight and costs have to be made, and in Chapters x. and xi. not only are the weight and cost of the steel structure dealt with but also a complete review is given of the hundred and one items found in every ship. The cost of materials varies with the locality and state of the markets; the cost of labour depends on the grades of workmen, their labour efficiency, and the general efficiency of management. Under the title "Wood and Outfit" are included the cement work used for preservation of certain parts of the hull, the wooden decks, floors, ceilings, hatch covers, gangways, cabins, fittings, mess rooms; iron fittings such as anchors, davits, bollards, ladders, gratings, staunchions, rails; the various systems of piping, the painting, rigging, canvas gear, boats, deck machinery, navigation instruments, steering gears, winches, the electric installation and insulation. Further chapters deal with the size and weight of propelling machinery, with resistance and screw propellers, and with service performances.

The text is accompanied by more than a hundred

tables of data, and a series of diagrams, curves, and sketches, the latter ranging from outline diagrams of types of ships to sketches of deck and cabin fittings. The book is one which will no doubt be found of use on many occasions and of value as a work of reference for everyday use.

Diatoms: Satis superque!

Notes on Diatoms: an Introduction to the Study of the Diatomaceæ. Compiled by Frederick Beatson Taylor. Pp. ii+269. (Bournemouth: The Compiler, 2a Montague Road, 1929.) 21s.

WHATEVER opinion may be held as to the general usefulness of such a book as the above, one pays homage to the industry and patience that went to its compilation. From Leeuwenhoek to De Toni, from 1703 to 1929, the author has ranged, collecting a mass of information that one piously hopes may be useful to the student of the group. Whether it assists in clearing up what Grunow described as "le chaos qui règne actuellement dans certains genres" is doubtful, and as an "Introduction to the Study of the Diatomaceæ" (which, by the way, is the title of Mills and Deby's book of 1893), it is much less useful than such a book as Hustedt's "Süsswasser-Diatomeen Deutschlands". Accompanying the book in a pocket at the end are five plates of illustrations of species, four being from outline drawings and one from photomicrographs, this last being by far the best of the plates.

The sixteen chapters contained in the book present the opinions, contradictory or unanimous as the case may be, of an army of authorities upon every phase of diatom life, many of the opinions being entirely obsolete and not a few grotesque. A loose sheet of corrigenda accompanies the volume, which, however, does not include all the corrections necessary; for example, the statement on p. 49 that Bailey dissolved valves of *Pinnularia* in *hydrochloric* acid. If the book is intended as a help to the beginner in the study of diatoms, the chapter on collecting and preparing diatom material might have been amplified and have included references to the excellent and practical directions for this work given in the books of Meister and Hustedt.

One cannot accept the statement made in Chap. iii., and repeated in Chap. viii., that the presence of diatoms in fresh water is an indication of its suitability for drinking purposes, and that a desmid flora should be regarded as a warning against doing so. I recently made a collection of diatoms from a farm-yard ditch that was largely contaminated with sewage, and the richest collection of diatoms I have ever made, both in species and individuals, came from a small pond the water of which no one would regard as potable. Whipple long ago gave examples of the fouling of water by a dense diatom population. On the other hand, desmids abound in lakes and reservoirs from which the water supplies of large towns are derived. Considerable space is devoted in the chapter on "Structure and Markings" to the controversial subject of 'resolution', but the beginner who reads the book as an introduction will probably be utterly lost amidst the contradictory opinions of the authorities quoted, many of which opinions are quite amateurish, and might well have been omitted in the interests of conciseness.

'Craticular' diatoms receive considerable attention from the compiler in this chapter. It is rather a cynical comment on the methods of some diatomists to find such forms elevated not only to specific rank but to generic rank also, as in the case of the genus *Craticula* constituted by Grunow. There can be little doubt that they are the result of a pathological condition. I have a slide containing numerous specimens of *Navicula cuspidata*, one individual of which shows the 'craticular' state in one hemisphere of the frustule, the other being quite normal. That the condition has nothing to do with changes in the salinity of the water, as was suggested by Marpmann, may be inferred from the fact that the species above named, which seems to be especially liable to the 'craticular' condition, is a fresh-water species.

Chap. xi., "The Species of Diatoms", wherein the compiler brings together the opinions of many authorities on the desirability of limiting the numbers of species, and reducing the number already in existence, will be read sympathetically by those engaged in taxonomical work on the group. Probably nowhere has the manufacture of species and varieties gone to such absurd lengths as in the Bacillariales, and unfortunately it still continues. Dimensional varieties, and even pathological forms, abound in the various text-books, and every new authority contributes his quota to the confusion.

In "The Literature of Diatoms", to which Chap. xii. is devoted, is brought together in chronological sequence titles of practically all the principal works on the Diatomaceæ, with the dates of their publication, and useful notes indicating the ground covered by the authors. No reference, however, could be found to "An Introduction

to the Study of the Diatomaceæ", by F W Mills and Julien Deby, published by Iliffe and Son in 1893, which contains a valuable bibliography of diatom literature up to that date When referring to Meister's "Die Kieselalgen der Schweiz", it is not made sufficiently clear that the work deals only with fresh-water species A list of monographs on various genera and books relating to the diatom flora of special areas adds to the usefulness of the chapter

A review of the genera of diatoms, with authors' names, and dates when the genera were established, is a chapter of the book that will prove of great service to historical students of the Diatomaceæ References are also given to the principal works in which the genera may be found No pains seem to have been spared to make this list as complete as possible, and an addendum to the chapter adds additional genera and references This chapter is probably the best and most useful in the book A good index is provided G T Harris

Our Bookshelf

Mathematical Geography By Prof A H Jameson and Prof M T M Ormsby Vol 2 *Simple Astronomical and Trigonometric Surveying, and the more Advanced Study of Map Projections* Pp viii + 160 (London Sir Isaac Pitman and Sons, Ltd, 1929) 6s net

The comment made in this journal on Volume 1 of this work was that it would be welcomed by geographers for its scope and clarity The second volume has now appeared, and continues the treatment of map projections more fully and completes the course which the authors set out to cover Vol 2 deals principally with the astronomical determination of position on the earth, more advanced surveying, and a progressive advanced treatment of map projections The influence of the spheroidal shape of the earth on map projections is also dealt with

The book is in general clearly written and, in spite of its more advanced character, easy to follow The illustrations are clear and suited to the requirements, although one may enter a protest against Fig 33 and the elaborate dual deductions which follow therefrom The section on photographic surveying, unfortunately, is only sufficient to indicate where a satisfactory treatment is to be obtained Surely such a modern development was well within the scope of the work, and was deserving of more adequate handling

Care has been taken in the preparation of the book—a feature evidenced by the freedom of the text from error The examples and exercises which are included in the work are an additional commendation This volume will be added to the list of useful books by all who are interested or concerned in this subject J Eling Coleclough

The Flood New Light on an Old Story By Harold Peake Pp x + 124 (London Kegan Paul and Co, Ltd, 1930) 5s net

Mr Peake's book on the Flood is an account, intended primarily for a popular audience, of the bearing of recent archæological investigation on the legend of an all destroying deluge This legend is world wide in its distribution, but it is best known in the version given in the Book of Genesis The author accepts the view that a common origin for the various legends is not probable, but the Hebrew version was most certainly derived from the Mesopotamian epic of Gilgamesh brought back to Palestine after the Captivity The discovery at both Ur and Kish of a stratum of clay of a thickness which could only be due to a considerable inundation has given reasonable ground for believing that the legend has here preserved a record of an historical event With this as the basis of his argument, Mr Peake expounds for the benefit of the public he has in view the wider question of the bearing of recent archæological research on the historicity of events once regarded as entirely mythical, but of which the record may now be regarded as enshrining an element of truth

Although Mr Peake's book is primarily intended to be of popular interest, scholars cannot afford to neglect it, for his account of the pre- and post diluvian culture of Mesopotamia is suggestive in its interpretation of the difficulties which at present offer puzzles for the archæologist Most ingenious of all, perhaps, and indeed a *vera causa*, is his suggestion that the discrepancies between the records and the archæological evidence relating to the early dynasties of Ur may have arisen from a misplacement of the tablets when the lists of the kings were copied

The Book of Electrical Wonders By Ellison Hawks Pp 316 + 41 plates (London, Bombay and Sydney George G Harrap and Co, Ltd, 1929) 7s 6d net

Electricity has so many applications, and it is so much in evidence everywhere, that it may be presumed that few of the rising generation of boys and girls are without some knowledge of batteries, dynamos, telephones, and vacuum tubes If the elementary principles are clearly explained, even the most complicated electrical machinery lends itself to popular exposition, and there is ample room for well written books such as that by Mr Hawks Within the space of some 300 pages he has been able to include a great deal of interesting matter regarding power stations, electric lighting, electric furnaces and welding, telephones, telegraphs, radio communication, X rays, photo telegraphy and television There are no fewer than 41 plates and 91 illustrations It is a book which will no doubt find its way into the hands of many boys, and it is essentially one to be included in the school library In the preface Mr Hawks says that Faraday's annual salary probably never exceeded £100 One is happy to think Faraday was paid more than that, and moreover, had he been so minded, he might have made a fortune

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

Science and Philosophy

THE leading article under this title in NATURE of June 7 is interesting not only in its exposition of the subject but also in marking a phase in the history of thought Throughout what is for the circumstances a fairly full discussion there is only one reference to biology, and this in the form of a hint that the fundamental ideas of that branch of science are in especial need of critical examination It is highly probable that in no such article written at the beginning of this century could the explicit reference to biology have been so slight both in substance and in tone The occasion indeed brings into sharp prominence the extent to which the biological sciences have, during the last thirty years, lost prestige in the intellectual world, and ceased to influence philosophic thought It is well that this fact, whether it ought to give rise to satisfaction or regret, should be clearly recognised Nevertheless, however complete may be its intellectual insignificance to day, the fact remains that in any attempted *rapprochement* between science and philosophy biology is still very much to be reckoned with, and not the less because during the late comparatively silent years it has been steadily adding to its store of knowledge, and especially in those of its branches that are specially relevant to the proposed work of reconciliation

A philosophy is an attempt to bring into harmony the verifiable truth of science and the intuitive truth of the mind That these two categories are, at whatever depth, identical is the assumption of the philosopher, it is also the assumption of the naive intellect, but the notorious effect of secular experience is to make the supposed identity less and less superficially obvious It was long thought that the two categories had a meeting place and common station in mathematics and that our intuitions of number and space did give us verifiable objective knowledge This has remained true of number because apparently internal experience of number is as good as external experience of it, that is to say, abstract number is indistinguishable from concrete number It cannot, however, any longer be accepted for space, for we now know that if the scale is large enough (and perhaps small enough) the intuitions we have formed on the strength of binocular vision and the so called stereognostic sense are not all verified by experience The developments in physics which are commonly supposed to have done so much for philosophy have thus, it would seem, incidentally taken away one of its time-honoured supports

It is, however, the developments in the biological sciences that appear to have done most to increase the severity of the philosopher's task, though the retreat of biology from its former position in the world of thought has tended to obscure this fact

In the reconciliation of verifiable and intuitive truth, the mind, if we may use a legal metaphor, is not only one of the parties to the action but also the judge The knowledge that the last thirty years have given us of the limitations and liability to error of the mind in what we may call its judicial capacity, is therefore highly relevant and certainly not less so than the advances in physics, which in relation to philosophy have attracted so much more attention That the wish is apt to be father to the thought, even in the highest and austerest activities of the mind, is no longer a mere proverbial tag but a scientific fact, and we now know that in appropriate circumstances desire can override all evidence The work of Pavlov, again, little as its implications for man have been followed out, and strangely ignored as it has been by the philosopher, contains matter that may well have to be reckoned with in estimating the validity of human judgment, especially perhaps in regard to our sense of causation

The biological conception of the mind as a natural product will have to be assimilated if philosophies in general are to lose those two characteristics which are so apt to discourage interest in them, first the tendency, however complete they may seem to their inventors, to prove intransmissible without gross modification, and secondly, the odd coincidence that after surveys of phenomena no matter how extensive and sublime, they so often but confirm the convictions and beliefs in which their inventors were bred

These are some of the considerations which make it seem probable that, in any successful *rapprochement* between science and philosophy, biology will have a more active part to play than merely to submit to the critical overhaul of its scientific concepts

WILFRED TROTTER

June 10

Developmental Mechanics of Chicken and Duck Embryos

IT has recently proved possible to cultivate young chicken and duck embryos *in vitro*, using the 'watch glass technique' employed at the Strangeways Laboratory for the cultivation of embryonic organs Experiments using a somewhat similar technique were made in this laboratory two or three years ago by T S P Strangeways and D H Strangeways, but the work was given up after a few trials and the results never published The embryos can easily be kept alive for two or three days and differentiate nearly normally, although the rates both of differentiation and of growth are slower *in vitro* than *in vivo* I wish here to summarise some experiments which I have recently performed on this material full reports will be published in the near future

At the stage when the primitive streak is fully grown but the head process has not yet appeared, the blastoderm can be removed from the yolk and the endoderm and mesectoderm separated from each other So far the isolated endoderm has never given any signs of differentiating *in vitro*, but the mesectoderm will form neural folds, somites, and a notochord If the endoderm and mesectoderm are separated and then brought together again in such a way that their original longitudinal axes are approximately at right angles, it is found, in chick embryos of the above age, that the embryo develops in the direction of the ectodermal axis, and that the endoderm forms a foregut in the correct place as determined by the ectoderm However, in a similar series of experiments on considerably less developed duck embryos, in which the primitive streak was not fully grown, that structure, as it lengthened and grew forward, was bent round towards the anterior part of the endoderm in later stages the embryos became straight, lying in a direction midway between those of the ectoderm and endoderm. This result appears to indicate that both the layers have a polarity, and that under the conditions of these experiments, both layers play a part in the determination of the axial direction of the embryo

If two mesectoderms, from two chick embryos of

the primitive streak stage, are placed with their ventral (mesoderm) surfaces together and are cultivated in that position, it is found that the primitive streak of the lower mesectoderm induces neural folds in the upper mesectoderm, which thus comes to have two sets of folds, its own original set and the induced set Probably the induction is mutual, each mesectoderm acting on the other, but as the lower mesectoderm rapidly degenerates, perhaps for lack of oxygen, this cannot be determined with certainty If there is a considerable difference in the degree of development of the two mesectoderms, the younger appears unable to induce neural folds in the older In several cases, in which an older mesectoderm has induced neural folds in a younger mesectoderm, and in which the direction of the induced folds was at right angles to that of the younger primitive streak, the younger primitive streak has failed to develop, and only the induced neural folds are present in the upper mesoctoderm As in the amphibia, the organising power is not species specific, since a duck primitive streak has induced neural folds in chick tissue, and vice versa

Grafting experiments, in which pieces of primitive streak, cleared of endoderm, have been planted upside down between the endoderm and mesectoderm of a host embryo, have shown that the organising power can be manifested by such isolated pieces this result can be taken as fairly definitely proved for the anterior end of the primitive streak including the primitive pit, but it is not yet entirely certain for the posterior part isolated from the primitive pit Here, again, certain grafts between the duck and chick have been successful These grafting experiments also make it clear that a developing neural tube can induce the formation of somites from mesoderm which normally would not form such structures It is hoped to perform similar grafts in the near future using the endoderm underlying the primitive streak

The phenomena described in the last paragraph, in which the primitive streak is found to induce neural folds, that is, primitive streak derivatives, are perhaps more nearly comparable to the 'homoiogenetic induction' of medullary plate by medullary plate in Triton than to induction by the dorsal lip of the blastopore

The hypothesis that the organising capacity of the primitive streak is inherent to some extent along its whole length, which is suggested by the grafting experiments, is also supported by the fact that if any part of the primitive streak is removed, regeneration takes place and in many cases a perfect embryo results The more posterior the piece removed, the easier it is regenerated The head rudiment can also be regenerated, presumably under the control of the primitive streak In this case the regeneration is usually incomplete two half heads are first formed, one on each side of the hole made by the operation, and these later fuse more or less well in such cases, the two heart rudiments may be prevented from fusing and two beating hearts are developed, it is not yet certain how far regulation goes on in the half hearts, which are bent, and are mirror images of each other. In contrast to the regeneration of the head under the influence of the primitive streak, it is found that if the entire primitive streak is removed, including the primitive pit and Hensen's knot it is partially, and sometimes quite considerably, regenerated

A certain amount of work has been done showing that regenerative processes can take place at a considerably later stage thus if the eye-cup and lens are removed from a 15 somite embryo, a regenerated cup and lens are formed which are at least morphologically perfect

It will be seen that the developmental mechanics of the chick blastoderm are decidedly complicated Probably there are several regions capable of acting as organisers in Spemann's sense, and, notwithstanding Hoadley's demonstration (*Jour Exp Zool*, vols **42**, **43**, etc) that some self differentiation of parts of the blastoderm can be obtained from very early stages, it seems to be true that the blastoderm retains for a considerable time enough plasticity to be affected by such organising regions As yet little is known about the limits of this plasticity and not very much about the distribution and potentialities of the organisers, though in the latter case perhaps enough is known to suggest a comparison with the gradient of susceptibility to poisons found by Hyman (*Biol Bull*, vol 52) C H WADDINGTON

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May 24

Researches on the X-Ray Spectrum of Sulphur

SOME results of an investigation of the effect of chemical constitution on the λ ray spectrum of sulphur have recently been published by me (*Zeit f Phys* **60**, 642 1930) As shown by Lindh and myself (*Ark f Mat, Astr och Fysik*, **18**, Nr 14 and 34, 1924 *Zeit f Phys*, **33**, 901 1925), the struc

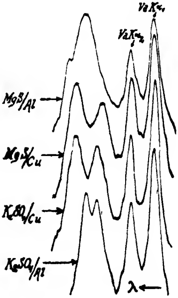

FIG 1

ture of the $K\beta$ lines of the elements sulphur and phosphorus does not depend only on the chemical state of the element under investigation, but also on the material used for the anticathode For some time I have been studying more closely this influence Some preliminary results obtained with sulphur, using aluminium for the anticathode, will be described here Of the various chemical compounds photographs are taken under the same experimental conditions as those in the work above mentioned (*Zeit f Phys*, **60**, **642**, 1930), where copper was solely used for the anticathode

On an aluminium anticathode magnesium sulphide gives except a rather intense β line with the wave length 5017 9 X U also a fainter, somewhat diffuse one of 5023 6 X U The difference in structure between

the β lines of magnesium sulphide on copper and on aluminium anticathodes is obvious from the photometer curves in Fig 1. The two lines at the right part of the figure are $K\alpha_1\alpha_2$ of vanadium, which are taken as reference. The photographs of calcium suphide show a rather sharp line at 5018 1 X U, which towards greater wave lengths seems to have a faint component at about 5021 X U. With strontium sulphide and barium sulphide the β lines have almost the same structure as on copper anticathode. However, the line 5018 3 X U with strontium sulphide on copper anticathode seems on aluminium to be separated into two lines. Also a very faint line at 5011 X U is visible with these two compounds. The broad emission bands, which were obtained with zinc sulphide and cadmium sulphide on copper anticathode are on aluminium separated into two lines, one rather broad and intense at 5017 1 resp 5017 0 X U and one fainter at 5023 2 resp 5022 1 X U. Further, the photographs of zinc sulphide show a faint line of 5031 3 X U and those of cadmium sulphide one of 5033 0 X U. At a closer investigation of the photographs of zinc sulphide and cadmium sulphide on copper anticathode here also small traces of these fainter lines are visible. Of the sulphides examined only copper sulphide holds its characteristic β doublet structure unmodified on aluminium anticathode. The peculiar structure of silver sulphide on aluminium (*l c Ark f Mat, Astr och Fysik*, 18, Nr 34, 1924) has anew been established.

Of the sulphates examined, only copper sulphate has the same structure on aluminium and on copper anticathodes. Fig 1 shows the difference in structure between the β lines of potassium sulphate on the two anticathodes. The wave lengths are on aluminium 5018 4 and 5014 9 X U, on copper 5020 6 and 5014 7 X U. The lowest curve is characteristic of the sulphates of the alkaline metals and the metals of the alkaline earths on aluminium anticathodes. Some of the sulphates also show a very faint and diffuse line of 5044 X U.

The wave lengths of the $K\alpha_1\alpha_2$-lines of the various sulphides on aluminium anticathode agree closely with the results obtained on copper. This is also the case with the α lines of the examined sulphates.

The results will be discussed more particularly when the present study of a larger experimental material has been finished.

OSVALD LUNDQUIST

Physical Institute of the
University of Lund, May 22

The Binding Energy of Some Organic Compounds

MECKE (NATURE, April 5, p 526) has recently revised several of his older estimates of the energy of dissociation of C H and C C bonds in organic compounds, obtaining values considerably higher than before. In these new calculations it is assumed that (*a*) the energy of removal of all of the hydrogen atoms in, say, methane, is the same, and (*b*) the carbon atom will be left in the ^5S state with an excess energy amounting to about 110 kcal. It is then possible to calculate binding energies by the same methods which had been used before when instead of (*b*) the assumption was made that a normal carbon atom would be formed; clearly, the new energies will be higher than the old by 110/4 or 27 5 kcal for C H bonds, and 110/2 or 55 kcal for C C bonds. The dissociation energy for C-H in saturated hydrocarbons is thus increased from 90 kcal to 117 kcal, and that of C C from 65 kcal to 120 kcal.

This value for C H may well be correct for methane, but it is probably too high for the higher hydrocarbons; in support of this opinion the experiments of Bonhoeffer and Harteck (*Z physik Chem*, 139A, 64, 1928), may be mentioned; it was found that methane was perfectly inert to atomic hydrogen, but that all higher hydrocarbons were dehydrogenated, suggesting that the binding energy of the C-H bond in methane is greater than the heat of dissociation of hydrogen, 101 kcal, while in the higher hydrocarbons it is less.

The value 120 kcal for C-C is even more difficult to reconcile with chemical data. It has become clear within the last few years that the initial step in the thermal decomposition of saturated hydrocarbons takes place as a normal unimolecular reaction; the best value which can be given for the energy of activation in such reactions is about 65 kcal. It is rather likely that the binding energy of the bond which breaks in a unimolecular reaction is about equal to the observed activation energy, but in any case it cannot be greater than this energy plus the average energy of the reacting molecules at the temperature used. For propane at 600° this later quantity will scarcely exceed 10 kcal, giving about 75 kcal as an upper limit for the energy of a bond in this molecule. It is not likely that there are any C H bonds with so low an energy as this, and it may therefore be assigned to a C-C bond.

The conclusion which these facts suggest is that the old, lower values for the C C bond, and for C-H in higher hydrocarbons, are preferable, and therefore that the complete dissociation of such hydrocarbons will yield carbon atoms in the normal ^3P state.

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April 18

Negative Attenuation of Wireless Waves

IN 1926 Ratcliffe and Barnett (*Proc Camb Phil Soc*, vol 23, p 300) directed attention to an anomalous effect which they had observed when measuring the attenuation of wireless waves of 1600 m wave length from 5XX, the Daventry station of the B B C. They obtained an attenuation curve of the form shown in Fig 1, which shows how the product ($E \times d$) of the

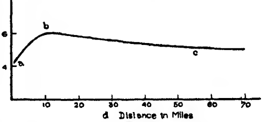

FIG 1

distance (d) and the electric intensity in the wave (E) varied as the distance (d) from the transmitter was increased. The falling portion (*bc*) of the curve represents, as is well known, attenuation of the waves due to losses produced by eddy currents flowing in the ground. The rising portion (*ab*) of the curve may be said to represent a 'negative attenuation' of the wave. At the time when the observations were made, no explanation of the negative attenuation could be given.

Since the publication of the original results, experiments have been performed to find out whether the negative attenuation effect is peculiar to the Daventry signals, or whether it occurs on all signals of this wave-

length Attenuation measurements made at Cambridge on a transmitter with a low aerial, working on a wave-length near 1600 m, showed no sign of the effect We therefore conclude that it is due to some special conditions at the Daventry site Two possibilities then present themselves either it may be due to the high aerial employed at Daventry (130 yd high), or it may be due to some special factors influencing the attenuation at the Daventry site It would be possible to decide between these two alternatives by investigating the attenuation at Daventry using a low transmitting aerial By kind permission of the B B C it is hoped to carry out this measurement in the near future In the meantime, it is of interest to investigate whether the effect could be produced by some peculiarities of the ground over which the wave passes This investigation can be carried out with the aid of some numerical calculations on Sommerfeld's attenuation theory (*Ann der Phys*, vol 28, p 665, 1909) which have recently been published by Rolf (*Proc Instit Radio Eng*, vol 18, p 391, 1930)

Rolf shows that, for certain values of the conductivity (σ) and the dielectric constant (ϵ) of the ground, we should expect attenuation curves of the form shown above, exhibiting the phenomenon of negative attenuation By comparison with these calculations we find that the observed curve can be explained if we assume $\sigma = 7 \times 10^{-15}$ e m u and $\epsilon = 80$ e s u The value for σ is not very different from that which has previously been found by other methods (tilt of the wave front, and attenuation on 400 m) The value of ϵ is, however, very different from that found previously (Ratcliffe and Shaw, NATURE, Oct 19, 1929, p 617), using waves of 30 m wave length We must, however, remember that there is every reason for supposing that both σ and ϵ will vary with frequency To investigate this variation, laboratory experiments have been carried out, in which these quantities were measured at different frequencies, for different specimens of soil It was found that ϵ increases as the frequency is reduced, and at 1600 m values of $\epsilon = 45$ were obtained for this quantity, and it was noticed that for these frequencies, the value of ϵ was increasing rapidly as the frequency was diminished It thus appears that here we have a possible explanation of the negative attenuation effect

Whether or not this is the correct explanation will only be clear when the measurements on a small aerial at Daventry are completed, and only then will we know whether the values $\sigma = 7 \times 10^{-15}$ and $\epsilon = 80$, deduced from the curve in this way, are correct

J A RATCLIFFE
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Cambridge, May 21

New Spectrum of the Hydrogen Molecule

In a recent note (*Physical Review*, May 1, 1930) I stated that I had observed a new system of absorption bands in hydrogen Since, because of its primitiveness, the hydrogen molecule is of great interest to physicists and chemists, I hasten to make these data available to other workers in this field Although at present the data are incomplete, I hope they are accurate enough to help investigators to establish another link between the ultra violet and the visible spectra of hydrogen and help clear up more of the ultra violet many-line spectrum

The new band system is especially interesting because it probably arises from the normal (A) state of the hydrogen molecule, and is by far the most intense of the hydrogen absorption spectra The observed bands are degraded to the red and form a v' progression representing transitions to vibration states connected with a new electronic level In harmony with former usage in the case of hydrogen absorption spectra, and pending a fuller investigation to establish its character, I shall call the new electronic level the D level The preliminary examination of this spectrum yields the following data The quantum designations, wave lengths, and intensities of the observed bands are (0 0) 838 62 (6), (1, 0) 825 85 (5), (2, 0) 814 32 (4), (3, 0) 803 86 (3), (4, 0) 794 23 (2), (5, 0) 785 75 (1), (6, 0) 778 18 (0), (7, 0) 771 35 (0) The formula that represents these is

$$\nu = 119244 + 1900v' - 59\ 524v'^2,$$

where ν is the observed frequency and v' the vibrational quantum number of the D level From these data it is seen that the molecular constants are $\omega_0 = 1900$ cm^{-1}, $\omega_0 x = 59\ 52$ cm^{-1}, and $D = 1\ 872$ volts, the energy of dissociation from the D state of the molecule

Using the value 4 465 volts as the heat of dissociation from the normal state in connexion with the data given above, one sees that the products of dissociation are a normal atom and one excited to the 3 quantum state The value thus deduced for the 3 quantum state of the atom is 12 22 volts, whereas the true value is 12 035 The discrepancy is not large, and is in the right direction when one considers that a linear formula was used to fit the data of the ω_v curve A further comparison of these data with the great amount of hydrogen data made so conveniently available by Prof Richardson in his report to the Faraday Society shows that the D level is quite new and that its denominator is 4 538

Some recent photographs showing some of the rotation lines of these bands are being examined in order to extend the analysis and to attain greater accuracy

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May 20

Association of Stimuli in the Development and Function of the Nervous System

An interesting connexion is to be found between two recent conceptions of the nervous system, in its development and function Pavlov's work indicates that the function of the cerebral cortex is the setting up of conditioned reflexes These, together with unconditioned reflexes, underlie the behaviour of an animal The conditioned reflexes are elaborated by association with unconditioned reflexes, " their function and extinction are determined by (one or several) coincidences in time of stimulation of the lower lying reflex centres, with the stimulation of the cerebral hemispheres through the corresponding centripetal nerves " (" Lectures on Conditioned Reflexes ", p 74) The *association* of stimuli (those causing unconditioned with those causing conditioned reflexes) is a fundamental factor in the nervous activity of an animal For example, the ringing of a bell will cause a dog to salivate (conditioned reflex) provided the sound of the bell has previously accompanied contact of meat with the dog's mouth, causing salivation (unconditioned reflex) It is the simultaneous or approximately simultaneous occurrence of different stimuli which is responsible for the creation of the conditioned reflexes constituting animal behaviour Thus the *function* of the cerebral cortex is dependent upon the concurrence of physical stimuli

Compare this with the theory of neurobiotaxis, formulated by C U A Kappers, which accounts for the *development* of the nervous system, and the material connexions in it In this case, associated

physical stimuli from various regions of a growing embryo are thought to determine the formation of the parts of its nervous system Kappers says "In the case of material alterations in the nervous system, only simultaneously associated influences cause the selection simultaneous (or immediately successive) stimulations bring about not only mental associations but also material connexions in the nervous system" ("Three Lectures on Neurobiotaxis and other Subjects", p 19)

It appears from the experimental work of Pavlov, Kappers, and other workers, that both the development of the nervous system and the function of its highest part, the cerebral cortex, are dependent fundamentally upon the occurrence of physical stimuli associated with each other in space and time The importance of this conception for science is obvious Since the mind is dependent upon the activity of the cerebral cortex, these recent theories of its development and function may not be below the consideration of philosophers

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The Neon Lamp as a Glow Relay

THE ordinary 'Osglim' neon lamp as made by the General Electric Co, Ltd, forms a convenient and sensitive glow relay if furnished with a third electrode which may take the form of a strip of metal foil 1½ in wide, pasted on the outside of the lamp to surround the internal electrodes The type of 'Osglim' lamp most suitable is that known as the beehive, in which the electrodes take the form of a disc and spiral

This form of glow relay is sometimes conveniently used in conjunction with a photo electric cell, to indicate when a required light intensity is falling upon the cell

The disc electrode of the lamp is connected to the negative end of a battery, and the voltage adjusted on the spiral until the glow discharge is just avoided, usually about 132 volts is sufficient

The external electrode of the neon lamp is connected to the cathode of the photo electric cell, and the anode of the cell to a suitable positive tapping on the same battery Illumination of the cell will then promote discharge within the neon lamp passing sufficient current to operate a magnetic relay

The glow relay with the external third electrode enables two circuits to be kept entirely separate from one another Not every 'Osglim' neon lamp is suitable, due to variations in the insulation resistance and probably also to less suitable gas pressure

These neon lamps also exhibit a photo electric property, if the voltage on the third electrode is just raised sufficiently to produce the discharge, illumination of the electrodes by, say, a gas-filled lamp will prevent but not discontinue the discharge

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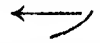
London, N 19, May 23

'Digging' in Rowing

IN most cases where a solid moves through a fluid, the total force of the fluid on the solid is nearly opposite to the direction of relative motion There is an exception in the case of a flat body such as an aeroplane wing, with its plane at a small angle to the direction of relative motion In that case the force is nearly at right angles to the direction of relative motion, and provides the means of keeping the aeroplane up If, however, the plane is too steeply inclined to the direction of motion, the force is again, as in ordinary cases, nearly against the motion, and we have the condition of 'stalling'

In rowing, the object is the opposite one, to keep the force as far as possible against the relative motion, but it seems to be worth while to point out that an oar can be turned into an aeroplane Imagine the blade inserted thus, and moved from right to left,



the blade being slightly inclined to the surface of the water Then the same theory applies as for an aeroplane wing, except that the leading edge is now the lower one Hence the force due to the water is *downwards* But the force due to the oarsman's pull is in the direction of motion, and no steady motion in a horizontal direction is possible If, on the other hand, the blade descended vertically, the force due to the water would become a resistance acting upwards It will be seen on a little consideration that the only possible motion is an accelerated one nearly in the plane of the blade, and resisted almost only by skin friction Thus the oar will rapidly shoot down to a considerable depth, while doing little to propel the boat

The phenomenon is, I understand not unfamiliar to oarsmen, especially when the blade is left near the 'feathered' position when reinserted in the water

HAROLD JEFFREYS

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The Accuracy of a Moth

THE square case made by the female of *Amicta quadrangularis* for pupation offers a good example of the ability for accuracy The case is about 1 1 inch long, and 0 2 to 0 3 square, formed of bits of grass stem broken off, and built in courses around the larva The diagram (Fig 1) shows the mean size of the

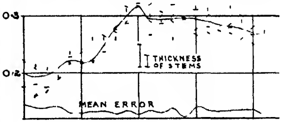

FIG 1

pieces beginning at 0 2 inch, widening to 0 32, and tapering to 0 27 The lengths of stem used on different sides are distinguished by four directions of the cross strokes It will be seen that the mean error, separately drawn below, begins at 0 02 and diminishes to 0 01, while the thickness of the stems varies from 0 04 to 0 02 inch The larva, therefore, makes an average error of only one half the thickness of the stem, and estimates the required length for the position usually to 0 01 inch, including the error of cutting, this precision is kept up for nearly a hundred repetitions A few layers near the beginning are omitted, as they overlap so that the ends are not clear The habitat is in the desert of South Palestine about ten miles south of Gaza

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The 1851 Exhibition Commissioners and their Work

THE Commissioners for the Exhibition of 1851 have published records of their scholarship schemes and the Press has directed public attention to prominent features in the results of the work of the Commissioners in this section of their activities. The *Times*, in referring to the remarkable results of the first and greatest of these schemes, has paid tribute to the foresight of the chief promoter of the Exhibition—Prince Albert. The tribute is indeed well merited. It was due to the Prince's vision that the Royal Commission was established for the Exhibition and was continued thereafter on a broader basis and with powers that enabled it to function to public advantage—with results perennial and far beyond the scale of its own material resources.

SCIENCE RESEARCH SCHOLARSHIPS

The essential factor in the influence of the Commission is its powers of initiation and demonstration. This feature is well illustrated by the scholarships' scheme, which did not take shape until forty years after the establishment of the Commission. In the course of these years the Commissioners had done a great deal to inspire the development of 'system' in national services for the promotion of science, art, and the industries; they had secured an estate in South Kensington as a 'locality' in which the State and other authorities could erect central institutions pertinent to such services.

It is clear that in the 'eighties the Commissioners came to the conclusion that *men* were lacking for the further development of their ideals, and the occasion produced the man who could find and 'make' such men—Lord Playfair—as Dr. Lyon Playfair, a commissioner from 1869. He acted as honorary secretary from 1883 to 1889, and in that period he carried through a process of financial change which replaced a deficit of the Commissioner's income in 1883 by a surplus of £5000 in 1889. He originated the Science Research Scholarship scheme, and, as chairman of the Scholarships' Committee for its first five years, he may well be said to have established the scheme.

The governing statement of that scheme is that the scholarships are "awarded to students who have passed through a university curriculum and have given distinct evidence of capacity for original research—to enable them to continue the prosecution of science, with a view to its advance, or its application to the industries of the country." From its inception the scheme took cognisance of students of universities overseas as well as of those at home. Right well has the scheme justified itself! The published "Record of the Science Research Scholars" gives ample evidence of the great and varied field the scholars have helped to enrich.

Conceived and maintained with full expectation of concurrent advance in the standard of preparation provided in the universities, the scheme met the needs for thirty years. In 1922 it was revised in view of the large development that had then taken effect in universities. From that year the awards have been under two categories: (*a*) Overseas Scholarships for selected students of universities in Canada, South Africa, Ireland, Australia, and New Zealand; (*b*) Senior Studentships for selected students of exceptional promise and proved capacity for original work. The Commissioners make their awards by selection in view of the recommendations of the institutions submitting names of candidates.

It will be noted that the change made in 1922 reflected a marked and welcome advance in the standards attainable within the limits of the facilities prevailing in the universities of Great Britain. By 1922 the universities had indeed been enabled to extend very materially the facilities they provided for advanced study and research—alike as to accommodation, facilities, and expert supervision and guidance. This provision has since been steadily increasing; in the past five years gifts from private benefactors and the financial help of the State through the University Grants Committee have made possible in the universities many advances in facilities and on staff that were, twenty years ago, but dreams.

The "Record of the Science Research Scholars" of the Royal Commission is remarkable—giving, as it does, for each 'scholar' particulars of his subsequent career. The pages of the list of scholars sparkle with names that call up most fruitful contributions to the progress of science! And, where personality counts for so much, it is refreshing to see in how many and how varied paths of life and lines of work these ex-scholars have rendered yeoman service and have been much sought after. Here is but a bare indication; yet even this is illuminating:—From 1891 to 1929 the number of those who passed out of their scholarship period is 562. Of these 7 died before obtaining scientific posts and 5 discontinued scientific work on the expiration of their scholarships. Of the 550, 240 engaged in teaching in universities (109 of them in the British Isles, 99 in the Dominions and India, 26 in the United States, and 6 elsewhere), 29 engaged in teaching in technical colleges and schools, 54 in research in universities, 91 entered public services, and 136 engaged in industries.

In reading these figures it must be remembered that a large proportion of those who become engaged in teaching continue their research work, and that not a few of these render expert assistance to industry; and, again, 'public services' to-day call for much specialised research which, in one way or another, reacts on industry. Indeed, careful reading of the detailed statements of the "Subsequent careers of Scholars" shows that their services to industry are both surprising and ubiquitous. The Record must be read: it is a document of great human interest.

Incidentally, the tabulated statements afford ample evidence of the extent to which the work of the 'scholars' has earned for them the appreciation of their fellow-workers in science and in the

industries To take one example 32 who had been 'scholars' are noted in that Record as having been elected fellows of the Royal Society, and this year's election has added 3 more

The Cost and How it has been Met

Now what does all this cost? The Senior Studentship and the Overseas Scholarship Schemes —together replacing the previous Science Research Scholarships Scheme—cost £11,000 a year This annual expenditure is greater than the interest on the whole capital of the Commissioners in 1852, and the Commissioners support other educational ladders

The surplus on the accounts of the 1851 Exhibition was £186,000, and the Commissioners have contributed liberally in sites and subsidies for the promotion of education in science and art—in every case deliberately and, with rare exceptions, with most fruitful results The particular case of the Science Research Scholarships illustrates the discriminating care the Commissioners exercised in initiating the service forty years ago and their continuing attention to the purpose and conduct of the scheme This particular scheme was—at its inception—a new departure and called for skilled and careful preliminary inquiry In these respects it was typical of most of the schemes they furthered or initiated When conceived, however, it had to face a particular difficulty In a later section of these notes it is stated that in 1877 the Commissioners aimed at establishing scholarships, but they could not then do so They had first to pay off debt incurred in developing their estate—the reserved part for public benefit, the outer ring for sale or long leases The Scholarship Scheme had to wait until they could float it—by the materialising of their area plan

The fact is that from 1850 the Commissioners have been 'Venturers'—not 'Merchant Venturers', but venturers in ideas relevant to progress in science, art, and industry The Science Scholarship Scheme was one of their 'ventures'—one of many It has been dealt with *here* as a type, and *now*, because its results have just been subjected to a long term audit Its place in the labours of the Commissioners, and in the unwritten and, indeed, impossible estimate of the services they have rendered to intellectual and material progress, can be visualised only by a wide survey of their work

The purpose of the following notes is to indicate briefly the record of their other ventures and to point to prominent achievements either by way of marking out promising fields or in exploring and testing little-known paths that might prove valuable lines to progress

The Royal Commission of the Exhibition of 1851

The present generation does not know the debt of gratitude it owes to the men who, in 1850, were incorporated as "The Royal Commission for the Exhibition of 1851", nor, indeed, did the previous generation. Those of *three* generations ago credited the Commissioners with great energy and sound judgment in promoting the success of the Exhibition After "1851" had set men a thinking, many noted with pleasure the continuous effort of the Commission to secure the full fruits of the ideas the Exhibition had sown widespread Quietly but steadily fruits were garnered and fresh areas enriched

How came it that the Exhibition could prove so effective a stimulant and how did its influence become permanent? The Commissioners appointed in 1850 were picked men—selected as representing the best and most active powers in many types of work—and they had in their chairman, Prince Albert, one familiar with the aims and methods in view—immediately and ultimately—one quick to understand conditions and energetic in securing action on decisions reached by the team he led The Prince Consort had been president of the Society of Arts for some years, in the course of which that Society had made a good beginning in the exhibition of British manufactures The Society proposed for 1851 an Exhibition of an international character and petitioned Royal sanction for the undertaking The Royal Commission and the Charter of Incorporation were issued early in 1850

The Exhibition

The Commissioners got to work at once They secured strong committees for the activities required at headquarters, and local committees were appointed in 297 towns and districts "Several gentlemen were selected to visit the more important towns" The newspapers gave valuable aid Despite many difficulties the Exhibition building—soon commonly known as the Crystal Palace—was erected on a site to the east of that on which the Albert Memorial now stands

The Exhibition was opened on May 1, 1851, by Her Majesty Queen Victoria

The Commissioners had worked hard they had gathered an able staff and they had roused enthusiasm in all centres of population, manufactures, and industry in Great Britain and Ireland, they had established relations with foreign countries and had elicited hearty and instructed co-operation in very many centres

The building was ready in good time The Exhibition contained contributions from nearly 14,000 exhibitors, of these, 53 per cent were from the United Kingdom and Dependencies and occupied 65 per cent of the total exhibition space, while 47 per cent were foreign and occupied 35 per cent of the space The exhibition was indeed international

These figures are taken from the "First Report of the Commissioners", published in 1852—a report which is a mine of interesting information it embodies many instructive details of arrangement and propaganda, of precaution and of record One inconspicuous item of record may be mentioned as affording an early example of the graphical illustration of related statistics This is a sheet of three diagrams printed in colours "Fig 1 Diagram showing fluctuations in the number of visitors, as affected by different days of the week,

different scale of payment, rain and heat of the building" "Fig 2 Diagram showing the relative fluctuation [in the numbers of visitors] on different days of the week [in successive months]" "Fig 3 Diagram showing the number of visitors actually in the building at every hour on three separate days" There is much of human interest in the appendices to the Report

In the body of that first Report, April 1852, the Commissioners stated that the surplus of the Exhibition accounts after the discharge of every liability would be not less than £150,000 The one major point of uncertainty then was the disposal of the Exhibition building, which had to be removed from Hyde Park In the end the "Crystal Palace" was bought by the "Crystal Palace Company", which had been formed for this purpose That Company took down the building and re-erected it at Sydenham

THE SURPLUS

When the Commissioners closed the Exhibition account in 1855, the amount at the credit of the account was £186,436 18s 6d This sum was then transferred to their Estate account, which had been opened by that time In the early months of the Exhibition it had become clear that there *would* be a surplus, and that this might be considerable It is on record that the Prince Consort was giving close attention to this matter in August 1851 Soon after the close of the Exhibition the Commissioners petitioned Her Majesty for a supplemental charter enabling them to prepare and submit a scheme for the application of the surplus, and, if their scheme were approved, to put it in operation Such a supplemental charter was granted on Dec 2, 1851

The Commissioners early satisfied themselves that no substantial national advantage would accrue if they were to distribute the surplus—as they had been pressed to do—among the areas that had contributed to the success that had attracted receipts They had made a careful survey (Second Report, 1852) of the existing position as to central and local institutions working in the interests of science, the arts, manufactures, the raw materials and the processes required in industries They had come to the conclusion that the most urgent needs were (i) improved conditions for the work of central institutions and (ii) the wide spreading of effectual methods of education and investigation bearing on these interests By their effective propaganda work in the preparation of the collections for the Exhibition, they had prepared the people and the Press for a forward movement in these matters The Exhibition itself had done much to stimulate thought and action which, well guided, might go far in its results

AFTER THE EXHIBITION—THE ESTATE

The assets of the Commissioners as disclosed in their Report of November 1852 were, in fact, their surplus *and* an idea The surplus was highly gratifying the idea was of even greater value 'System and a Locality' was their watchword They urged more systematic facilities for study and advance in science, the arts, and industries They proposed to find room for central developments on a systematic basis, and to leave to individuals, corporations, and authorities the promotion of the different interests that concerned them They had themselves taken preliminary steps to secure a 'locality' In 1852 they arranged to purchase, at a cost of £60,000, the Gore House estate of 21½ acres Profiting, however, by the unfortunate experiences of other authorities in acquiring property in London, and knowing that the Government had been repeatedly urged by Parliament to provide an extension of national institutions, they took steps to secure national control of a larger area than was required for their own purposes They passed a resolution authorising the outlay of a sum not exceeding £150,000 of the surplus in the purchase of land, including the Gore House estate, on condition that the Government would recommend Parliament to contribute a like sum towards the purchase of land on terms to be arranged The Government gave this assurance The de Villars estate and portions of the Harrington estate were purchased under this agreement, which, in practice, amounted to a temporary partnership These purchases enabled the Commissioners to lay out this group of properties for buildings of determined types, and to construct roads on a scale conformable with their general scheme

LOCALITY

Their scheme contemplated that there should be preserved for public purposes (*a*) almost the whole of the area extending between the Queen's Gate of to day on the west and Exhibition Road on the east, and from Cromwell Road on the south to the site on which the Albert Hall now stands, (*b*) the south eastern block of land now identified with the Victoria and Albert Museum

The latter block of land was taken over by the Government for £60,000 in 1861 The iron building that formed the nucleus of the South Kensington Museum—now the Victoria and Albert Museum—was erected on it in 1857, and was formally visited by H M Queen Victoria and Prince Albert, previous to its opening to the general public Further, more permanent, sections surrounding the garden court were erected in the course of years, and the main building which occupies the south and west fronts, and indeed the major part of the site, was opened by H M King Edward VII in 1909 The other buildings on this section of the area are on its north-western corner these are the original building of the Royal College of Science on the Exhibition Road front, and the Royal College of Art behind

In 1864 the Government bought from the Commissioners, for £120,000, the ground in the centre of which the Natural History Museum now stands On the north-eastern corner of this area the new building for the Geological Survey and Museum is now in course of erection

In 1888 the Government took over from the Commissioners for £100,000 the ground and buildings

between the foregoing block of land and Imperial Institute Road

Each of these three land transactions was governed by the restriction of the use of the site to "purposes connected with Science and Art", and in view of this condition the transferences were made at less than half the market value of the ground at the times of sale

These transfers concluded the major sales of land in the history of the Commission The net result appears to be that (1) the Government obtained on most favourable terms two great sites of first-rank value, (2) the Commissioners retained under their own control an adequate central area for the development of institutions in furtherance of their aims, and (3) the Commissioners retained a surrounding area available for sale or lease for beneficial occupation by others on terms which would regulate the amenity of the locality and at the same time yield, from sales and ground rents, a satisfactory revenue for disposal by the Commissioners in furthering the objects for which the Comsion was established

SYSTEM

In their Second Report (1852) the Commissioners directed attention to the need for further and more systematic efforts for the promotion of science and art in Great Britain—instruction for its industrial population—facilities for the exchange of results of study and investigation between investigators as well as between these and the public In their Third Report (1856), they refer to the establishment of "the Department of Science and Art" in 1853, and they record and illustrate the establishment or strengthening of various central and provincial institutions engaged in promoting science, art, and the industries, or in bringing inventions, designs, etc, before the public by museum representation Truly the seed had been wide scattered and was burgeoning well Yet not even to day do we see the full crop The prospects, however, are promising

The Department of Science and Art proved to be an effective pioneer Active local authorities soon found in the Department a perennial fountain of assistance—trickling at first, but always helpful To day the activities it fostered in all parts of the country are fed systematically through the Board of Education and Local Authorities They gain strength steadily

In 1852 the Commissioners had refused to distribute cups from the spring of enlightenment Obviously they preferred to work for the development of a real and liberal national supply system Being wise, they did not advertise their expectation The occasion was not opportune nor was the prospect promising Their work did much to promote the aim, but they could not have imagined that the full development of 'System' would be a matter, not of years, but of generations !

THE PRINCE CONSORT

In December 1861 the Prince Consort died The Commissioners, in their next Report (1867), wrote "The Address presented by us to Her Majesty on that sad occasion embodies the sense entertained by us of the irreparable loss we are called upon to sustain by the great Prince's removal from our head—a loss the extent of which each day's experience only tends to confirm"

We of the third and fourth generations sympathise most fully We also rejoice in many and bountiful crops which his vision and the wise administration of his successors have secured

(*To be continued*)

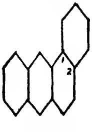
Tar Cancer

THE fact that workers in the shale industry show a relatively high incidence of cancer led to the discovery that certain tar products which had been exposed to high temperatures could produce cancer when painted on the skin of mice It was then found at the Cancer Hospital Research Institute that heating a variety of materials, such as acetylene, cholesterol, human skin, muscle, or hair, and yeast, to temperatures of 700° 900° resulted in the production of carcinogenic agents Attempts were next made to produce similar substances at lower temperatures, and Schroeter, some years ago, found that when aluminium chloride acted upon tetralin (commercial tetrahydronaphthalene) at 30°-40°, a mixture of high boiling compounds was formed

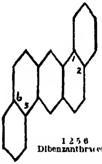
E L Kennaway and I Hieger (*Brit Med Jour*, June 7, 1930, p 1044) have recently reported that this material is carcinogenic as well as that prepared at 60°-70°, they noticed that the concentration of the aluminium chloride had to be above a certain minimum and that the treatment had to last a certain minimum time for the production of active material Later observations suggested that the carcinogenic agent might not be produced in effective amount at body temperature, but that its concentration was increased by the heating necessary to distil off the unchanged tetralin This line of research was, however, temporarily dropped when the authors noticed that this carcinogenic material shows a blue violet fluorescence, especially intense in a beam of ultra violet light The fluorescent light gives a spectrum with three bands at approximately 4000, 4180, and 4400 A

Examination of a large number of pure hydrocarbons and other substances was then undertaken, but without the discovery of one showing these bands 1 2 benzanthracene, however, gives three, resembling them in character and position relative to one another, but lying slightly nearer to the invisible region Addition of aliphatic or aromatic side chains to the benzanthracene molecule shifted the spectrum towards that of Schroeter's mixture, but none of these compounds has yet been found to be carcinogenic Condensation of another benzene ring with the benzanthracene nucleus

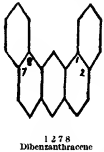
produced some compounds which both showed the three bands (but again shifted towards the invisible region) and were at the same time carcinogenic. The 1 2,7 8 compound was the most potent, but tumours were also produced by compounds of the 1 2,5 6 series.



1 2 Benzanthracene



1 2 5 6 Dibenzanthracene



1 2 7 8 Dibenzanthracene

Twort and Fulton found that chrysene is carcinogenic; its fluorescence spectrum is similar to that of benzanthracene but lies considerably nearer the region of short wave length.

The spectrum of Schroeter's mixture is given by a number of carcinogenic tars, including those obtained by heating certain animal or vegetable tissues. If acetylene tar is saturated with chlorine the bands are shifted towards the benzanthracene position and the carcinogenic potency at the same time reduced. Certain carcinogenic agents fail to give the bands, whilst a few substances showing them are not carcinogenic. It thus appears that the spectrum is not specific for carcinogenic agents, but the presence of the spectrum without activity may merely indicate that a carcinogenic agent is present but in too low a concentration to affect the skin of a mouse; the fluorescence test is a much more delicate one than the production of cancer in mice. The frequent occurrence of this spectrum may, however, prove useful in the preliminary examination of various substances suspected of carcinogenic effect, and may finally lead to the detection of a pure compound or compounds having this action. When reached, this result may throw light on the origin of cancers developing spontaneously.

Obituary

Dr Fridtjof Nansen

DURING most of his lifetime the whole world has acclaimed Fridtjof Nansen as a man of the first magnitude, and his fame has grown as his years increased. His outstanding figure shines in history by its blending of almost all the elements of human greatness, and probably this is why the press writers of to-day, when setting forth his claims to immortality, have so often been swept away in a flood of panegyric. I knew Nansen for forty-one years, from the time of his first crossing of Greenland, throughout the struggle to launch his *Fram* expedition, and the laborious years spent over the scientific reports on the work it accomplished. I was with him year after year at the meetings of the International Council for the Exploration of the Sea, and at other scientific gatherings in many lands. He was frequent in his correspondence on questions regarding our common interests and the glow of his unfaltering friendship warmed my life. Knowing the difficulties he had to overcome as well as the triumphs he achieved, I trust that it is not presumptuous for me, now that few remain who knew him better, to survey his career from the point of view of a contemporary.

Thirty-four years ago I reviewed in these columns (NATURE, Dec. 31, 1896, vol. 55, p. 201) an English translation of the life of Nansen, which was written when most people believed that he had perished in the Arctic. There is little in that article that I wish to change, and it may still be read as supplementary to this.

Nansen had a great heredity in which the elements of his own personality can be clearly traced. Without going back to the old Viking strain which came out in his magnificent stature and rugged features, we find full proof in the recorded family tree. His great-great-grandfather, born at the end of the sixteenth century, was a Dane, Hans Nansen, who as a lad spent a winter frozen in the ice of the White Sea, as a young man commanded a ship in the Iceland trade and wrote a book on the wonders of the sea, later becoming *Burgomaster* of Copenhagen, a prominent politician and a fervent patriot. His grandfather, Hans Leierdahl Nansen, nearly a hundred years later, was a Norwegian by settlement, a judge and government official, a keen politician, a man of many words rather than of action, but a patriot of the perfervid type, determined, if Norway must enter into close alliance with Sweden, that there should be no phrase in the treaty of union which could imply any inferiority in the partnership. His father, magniloquently named Baldur Fridtjof Nansen, and an aristocrat on his mother's side, was a quiet, studious man, occupying a responsible position in the legal profession, indifferent to outdoor sport, very strict in his parental oversight, governed in all things by inexorable principles. His mother, on the other hand, was a practical, energetic, strong-minded person who, as a girl, had horrified the prim society of the period by taking up the unmaidenly sport of ski-running, in which she excelled.

Nansen was born on Oct. 10, 1861, in a small country house at Store Froen in Aker, near Oslo; they gave him the name of the hero of an old saga, and never was there an apter christening:

As the acorn wins to a sapling, as the sapling waxeth an oak,
A goodly guard of the forest, and fronting the storm-wind's stroke,
So grew in his beauty Frithiof; he waxed a man among men;
In his heart was the love of all things, and his might was the might of ten.

Like his namesake of the northern mists, young Fridtjof grew up in the open, bathed in the ice-cold waters, risked his life a hundred times on fjord and fjeld, and beat all his comrades in every manly sport When a student his name was noised abroad as the champion ski-runner of Norway, and his holiday excursions over the high fjelds in winter were marvels of endurance He was probably no better at book learning than most of his contemporaries at the University of Christiania His true education came from his contact with Nature in a land where the contrasts of scenery, of climate, and of season are at a maximum, serving by turns to sting life into action and to awe thought into sombre introspection A strong poetic vein came to him from his ancestors in the midst of his most strenuous exertions he would give expression to emotions that an ordinary athletic Englishman might be tempted to scorn as sentimentality, yet they were part of the man

At the age of nineteen Nansen decided to take up biology as his life work Text-books did not attract him, but research was a mode of learning that made an appeal To take a real grasp of any truth he had to discover it, or at least to recognise it, for himself Priority was a question which did not trouble him at any time, in conducting an investigation he was intent on solving a problem which interested him mainly as a difficulty which he had undertaken to overcome

Nansen's biological researches won for him the curatorship of the Bergen Museum and his Ph D degree, they were characterised as promising by the specialists, but they were probably little in advance of the average of post graduate work Biology was not the master passion of Nansen's life, but it set him on his way when, in 1882, on board the sealer *Viking*, in the investigation of the polar fauna he first saw Arctic ice At the age of twenty six he seemed to be heading for a comfortable biological chair in a university, but the spirit of his fathers had leaped from the northern waves and pointed to another field of fame

It is difficult for the present generation to realise the opposition to which Nansen's project of crossing the Greenland inland ice gave rise Whymper, Nordenskiöld, and Peary had all tried to advance over the ice cap from the west coast and all had failed This young man resolved to succeed, first halving the distance to be traversed by starting from the east coast and providing no line of retreat He wished to go forward, and forward he had to go, for there was no possibility of going back He was to take a small party, and he devised light gear and special cooking apparatus The authorities said no one could carry out such a plan, Nansen knew he could, and he did He had been sure of success from the first and upheld his faith in himself with a firmness that would have struck a stranger as presumptuous obstinacy but for his modest bearing and the disarming sweetness of his smile

Nansen's natural self-reliance and stubbornness were increased by his success and by the year's lecturing in all parts of Europe which followed His mind conceived the far more ambitious project of reaching the North Pole Impressed by the extent and strength of the East Greenland Current and the vast quantity of ice and drift wood which it carried southward between Greenland and Iceland, he studied the problem of its origin and arrived at the conclusion that it must arise near the Siberian coast and probably flow across the pole He proposed to reach the pole by "taking a ticket with the ice", so he put it, from some point north of Siberia, and letting it drift him across, be the time required what it might He was confident in his own deductions and in the strength of his ship He planned her not to resist the ice but to compel ice-pressure to lift her on to the surface of colliding floes Once again he relied on the Forward policy, providing no line of retreat, staking his life and reputation on his faith in an idea In the words of his mythical namesake, he might have said to those who tried to turn him from his purpose

Now once for all I have chosen, the cost of my choice
I know,
And there lives not the man shall stay me the way that
I choose to go

Like his mythical namesake, too, he had an invincible ship, and a crew of true men, all equals, messing together and working together, and all devoted to their leader The ship he named *Fram*, which means 'forward', and forward he went, defying all the rules of earlier polar exploration Again, in the teeth of all expert advice and every traditional dictate of prudence, Nansen achieved success, though he did not reach the pole

Nansen's fame was established, but there was no change in the man He could not be any surer of himself or any more determined in the assertion of his own opinion than before, but he stood the storm of applause, unperturbed by the medals and the orders, the banquets and the flatteries, the publicity and the fortune which resulted I have known almost all the great explorers of my time, and Nansen was the only one on whom an overwhelming success left no jetsam of deterioration His manner remained as modest, his smile as winning as before Not that he attained to any superhuman perfection He still liked to draw the public eye, though he no longer displayed his fine figure in the tight fitting athletic costume which attracted so much attention in the streets of the capitals after the Greenland expedition He had not foreseen the depth of the Arctic Sea, and his oceanographical apparatus was inadequate In his great march on the ice he had let his watch run down and lost his longitude, but from a boy he had felt himself under the influence of a lucky star and he had won through by sheer force of body and mind

Physical oceanography took the first place thenceforth in Nansen's researches, and for several years he worked on the "Reports" of the *Fram* expedition, striving to make up for inadequate equipment by getting the very utmost out of the cleverly devised emergency methods used on the great drift The scientific results were certainly of far-reaching value, but the chief glory of the *Fram* expedition was that it gave the death-blow to the

(*Continued on p* 943)

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Recent Discoveries of Fossil Man *

By Sir ARTHUR KEITH, F R S

GARDARENE MAN

A REMARKABLE discovery was recently announced by Dr F C C Hansen, professor of anatomy in the University of Copenhagen Prof Hansen is the leading authority on all that relates to the anthropology of Greenland, his monograph on the craniology of the Eskimo being the standard treatise on this subject Recently he received from Greenland a series of human bones discovered during the excavation of a twelfth century grave yard which had been attached to the cathedral church of Gardar (Igaliko), south west Greenland In one grave the remains of a bishop were found with crosier by his side and gold ring on his finger, the other graves contained the bones of Norsemen (Vikings) who settled on the west coast of Green land, just north of the southern end, early in the eleventh century Amongst these bones Prof Hansen discovered a lower human jaw and a large part of a human skull manifesting characters more primitive and more massive than even those of the Rhodesian fossil skull These peculiar bones were not fossilised, they were in the same condition as those of the twelfth century Norsemen

There is a possibility, seeing how prehistoric the Eskimo are in feature and ways of living, that some belated representative of fossil man—okapi like—might have survived in Greenland until Norse times and his remains might have thus come to be buried in an early Christian cemetery Having seen only imperfect accounts of what had been found, I wrote to Prof Hansen, who, although he has not published the results of his investigation, has with great liberality sent me drawings and photographs and a full description of the remarkable specimens which have come to Copenhagen That the bones represent an extraordinary and undescribed type of man there cannot be a doubt The lower jaw is more massive than has ever been found in a human face—yet it is regularly formed and of enormous strength That part of the base of the skull to which the neck is attached has expanded into great plate-like buttresses of bone The hinder (occipital) part of the skull is sharply bent as in the Java skull, the newly discovered Peking skull, and in the Rhodesian skull The temporal muscles of mastication have expanded upwards on to the top of the head until they almost meet—as in the female gorilla Although the fore head has been partly lost, it is clear that it was low and receding, and that the skull must have been of enormous length (235 mm)—nearly an inch longer than the longest fossil human skull known to us But, like early fossil skulls, it was very low in the roof—the vault rising not more than 108 mm above the ear passages The face was two inches longer than the face of the average Norseman The walls of the skull were not unduly thickened, but certain appearances in the finer structure of the bone suggest that growth was not quite normal

To this old but undescribed and hitherto un recognised type of humanity, Prof Hansen has given the name *Homo gardarensis* The problem anatomists have to solve is How did *Homo gardarensis* come to be buried in an early Christian Norse graveyard in Greenland? Prof Hansen will have nothing to do with the 'okapi' theory—he refuses to suppose that a prehistoric type of humanity could have survived in Greenland, there is no trace of Eskimo in Gardarene man The explanation he offers is this Certain of the Norse graves contained bones of big headed, very muscular men He thinks that in an isolated Norse colony, where families of exceptional strength of body had been segregated, there had been a degree of in-breeding which called forth in some child the latent inheritance of antiquity, that *Homo gardarensis* may therefore be looked upon as an atavism—the reproduction of a type of man long since extinct

In the Museum of the Royal College of Surgeons there is a series of skulls which throws light on the nature of *Homo gardarensis* Twenty years ago I became interested in that peculiar disorder of growth known as acromegaly—a disorder due to a derangement in the organs of internal secretion, the pituitary gland being the one chiefly at fault The skulls of men who suffer from acromegaly, assume—in a bizarre form—all the characteristics of the

* Abridged from six lectures given in the Royal College of Surgeons of England on May 5, 7, 9, 12, 14, 16, 1930

skulls of ancient fossil man—particularly Neanderthal and Rhodesian characters Giants, however, particularly in the first stage of this disorder, assume such cranial characters in a much more regular way—all parts of the jaws, face, and skull proceeding to a harmonious excess of growth Certainly the specimens described by Prof Hansen exceed in size and regularity the giant specimens in the Royal College of Surgeons, but they are manifestations of excessive growth of the same kind *Home gardarensis* must have been the subject of a disorder of growth—the kind of disorder which causes giantism in man, but whereas in most giants growth soon becomes irregular, in *Homo gardarensis* it remained regular

When we have classified this strange descendant of a Viking with giants we have not explained all The growth mechanism which is in each of us is a heritage from fossil man It is therefore quite possible, as Prof Hansen maintains, that *Homo gardarensis*, although not found in a fossil state, may reproduce a stage of man's evolution which may yet be actually discovered in a fossil state The Gardarene skull in some points resembles that of giant O'Brien in the Museum of the Royal College of Surgeons, in others the skull of the Bristol giant—Patrick Cotter, described by Prof E Fawcett in the *Journal of the Royal Anthropological Institute*, Vol N S 12, p 196, 1909)

Colonisation of Europe by Neanthropic Man

The pioneers who took possession of Europe on behalf of the white (Caucasian) race of mankind began to arrive at a certain phase of the last period of glaciation There is still a wide difference of opinion amongst experts as to the number of times northern and central Europe became entombed beneath an ice sheet during the Pleistocene period, but nearly all are agreed that the last ice age was divisible into three phases There was an opening phase marked by great falls of snow and a southward spread of the ice-sheet, there was a middle phase, very cold but comparatively dry when central Europe took on the aspect of the steppes of Russia, then came the third or final phase, one of great snowfall and severe cold This triple division of the last ice period, so important to the student of fossil man, seems to find an explanation in a theory recently formulated by Dr G C Simpson,[1] who points out that as the maximum phase of cold is reached snow does not continue to fall more, but less abundantly, for two reasons The atmosphere at the equator and poles, becoming colder, can take up and carry a much smaller burden of moisture; the air currents which carry moisture from equator to poles fail because the difference in temperature between equator and poles becomes less The optimum conditions for snowfall and glaciation occur at the opening and closing phases of an ice age It was at or near the beginning of the middle or cold and dry phase of the last ice age that the white race of mankind began to take possession of Europe

Our evidence is now sufficiently extensive to assure us that until the coming of the white pioneers—the Cromagnons and Předmostians—Europe had been inhabited by, and in the sole possession of, men totally unlike any race now living—men of the Neanderthal type The increasing severity of climatic conditions in the opening phase of the ice age may have pushed Neanderthal man towards extinction, but the climatic change cannot be held accountable for his complete disappearance, for many lived in Spain, southern France, and Italy beyond the range of arctic conditions When we look at the forerunners of our kind, the disappearance of Neanderthal man can be understood

Until recently our knowledge of the early colonists of Europe was founded on discoveries made in the caves of central and southern France That was because French archæologists had moved ahead of their brethren in other countries It was thus we came to know of the tall, big-headed, strong Cromagnon people, they were cavemen Even in France, however, people at this early period camped in the open, at Solutré a great field station has been explored, the fossil remains of the people have been discovered there, and their hunting mode of life determined Recently Moravia—now a province of Czechoslovakia—has begun to rival France in the contributions she is making to our knowledge of the early white or Caucasian settlers In the middle—or cold and dry—phase of the ice age, large parts of Moravia became gradually covered over by drifts of loess—a fine earth The loess drifted over the open camps of the mammoth hunters, burying their hearths, refuse heaps, utensils, weapons, ornaments, and works of art where they are now preserved deeply buried under many feet of loess Dr D K Absolon, curator of the Government Museum at Brünn (Brno), has recently explored by trial shafts such an ancient camp near Wisternitz (Vestonice), and finds that it extends over hundreds of acres Brunn itself is built over several such stations, the grave of an old mammoth hunter was found deep beneath one of its main streets Two years ago, when the foundations of a house were being dug in the suburb,

the grave of a woman of the same early period was opened

The most famous, however, of the open stations in Moravia lies at Předmost on the eastern side of the province Although this station has been known for fifty years, its extent is only now being revealed along the sides of trenches cut in the loess by a brickmaking company It was in the loess at Předmost that the late Prof Maska discovered the tomb of the mammoth hunters, in which lay the remains of twenty individuals—men, women, and children—the earliest family or common tomb known Although this discovery was made more than thirty years ago, it is only now that anthropologists have had an opportunity of determining the racial characters of the people buried in the tomb For this opportunity they are indebted to Dr Absolon, who has distributed exact casts, not only of the skulls of the mammoth hunters but also 'brain casts' taken from the interior of the skulls The brains of the mammoth hunters, even when measured on our modern standard for Europeans, were large and richly convoluted These Předmostians were not tall like the Cromagnons of southern France, but short and stout, and like the Cromagnons they were big headed, strong jawed, and of muscular build The physical differences which distinguish the Předmostians from the Cromagnons are of a local nature—such as distinguish the tall Gallowegian Scots from the shorter people of Kent

Anthropologists have been strangely chary in applying a racial label to those early invaders of Europe—the Cromagnons and Předmostians When we look round the world—ancient as well as modern —for their nearest of kin, it is not in Africa, Australia, or in further Asia that we find them In all their characters they are Europeans or proto Europeans They differ from modern Europeans chiefly in size of jaw and the robust development of face, and of thigh bone Dr Absolon believes the Předmostians must have come from Asia, their culture appears to have been derived from there It is likely we shall also trace the Cromagnons to Asia, but there are many who believe that the weight of evidence favours North Africa as their homeland The Cromagnon people became modified in Europe, but their cradle of evolution lies elsewhere Since the time these settlers brought the Aurignacian culture to Europe there have been many invasions, but it is quite possible that Cromagnon and Předmost blood may flow in the veins of men and women still alive in Europe

When we follow, by means of dated burials, the history of Europeans through the third phase of the last ice age—we find food for reflection In the rigours of the last phase tallness disappeared, but the people remained muscular and big headed They lived under such conditions as the modern Eskimo live, and their jaws and certain other parts of the skull took on an Eskimo strength of development Under this mask, however, in nose, forehead, chin, and face can be seen the essential marks of the Caucasian Later still, when modern climatic conditions were dawning, which on the reliable data provided by Swedish geologists, we may suppose to have happened 10,000 or 12,000 years ago, the physique of Europeans became more reduced There were, so far as we know, no tall people in Europe then, big heads and strong jaws had become uncommon The people became small in body with slender bones, but whether these Europeans, which saw the dawn of our present climatic conditions, were the degenerate descendants of the great pioneers—which seems to me not unlikely—or were new invaders, we cannot yet say It is just when glacial conditions were giving way to more temperate times that our knowledge of our European ancestors becomes most deficient

The Ancient Inhabitants of Palestine

An account may now be given of the men and women whose fossil remains have been discovered in cave deposits of Palestine In 1925 the British School of Archæology opened a new chapter in our knowledge of the ancient inhabitants of the East In that year Mr Turville Petre, while excavating a cave on the western shores of Lake Galilee, on behalf of the School, discovered a deep and intact stratum containing objects of that very ancient stone culture —the Mousterian—which in Europe is always associated with Neanderthal man Mr Turville Petre found in this stratum part of a human skull which was Neanderthal in type, thus proving that Palestine, at a remote period, had been inhabited by men of the Neanderthal type, and that, as in Europe, their culture was Mousterian In a neighbouring Galilean cave he found stone cultures which correspond to those which succeed the Mousterian in Europe, but as no human remains were present it was impossible for him to determine whether in Palestine as in Europe there had been a sudden replacement of Neanderthalians by men of the modern (neanthropic) type

Three years later (1928) this blank in our knowledge was made good by Miss Dorothy Garrod On behalf of the British School of Archæology she began the exploration of a cave situated at Shukbah

on the western slopes of the Judæan hills, about midway between Joppa and Jerusalem In the deepest part of the cave she found—as Mr Turville Petre had done in the Galilean cave—a Mousterian stratum, and fortunately this stratum contained heavily fossilised fragments of human bones These were submitted to me, and I was able to confirm their identification as parts of Neanderthal man The overlying strata contained a stone culture known as upper or late Capsian, a culture which corresponds with the later Aurignacian of Europe In the Capsian deposits were remains which represented about two score of people of the modern or neanthropic type—men, women, and children Thus was proved that in Palestine as in Europe there was, in later Pleistocene times, a replacement of both race and culture

In the spring of 1929 it became necessary to explore a large cave in the western flank of Mount Carmel, as it was then proposed to open a quarry at its site The Director of Antiquities for the Government of Palestine made preliminary excavations and was rewarded by rich archæological discoveries He requested the British School of Archæology to undertake the exploration of the Carmelite cave—one of very great size Miss Garrod, although she had not completed the exploration of Shukbah, took charge on behalf of the School, and pitched her camp on the plain of Sharon just under the western flank of Mount Carmel In her hands the cave is proving to be a vast archæological treasure house Palæolithic implements occur in thousands, there are carvings and other works of primitive art There is a succession of well-marked strata indicating that the cave was inhabited by man at various periods of the Pleistocene period The deepest stratum is Mousterian, that as yet remains unexplored Over it came strata containing a succession of Aurignacian cultures (middle Aurignacian and later) Then follow deposits containing cultures which mark the end of the Palæolithic period Nowhere in the strata was there any trace of pottery, or any suggestion of agriculture The inhabitants lived on the natural produce of valley, plain, and shore—which is but three miles distant

In this Carmelite cave almost every stratum contained human fossil bones—sometimes mere fragments, at other times almost complete skeletons A full report on the human remains cannot be prepared for the School of Archæology until Miss Garrod has completed her labours at Mount Carmel and Shukbah A preliminary examination, however, makes quite clear that these Aurignacian inhabitants of Palestine were neither Jews nor Arabs They were a small sized people, with short faces, long heads, very different from the tall, strong Cromagnon people of France—their contemporaries Their faces were short and their noses were low-bridged and flat, with a distinct suggestion of African origin in them Indeed their derivation from North Africa—or an affinity with the people who occupied Algiers and Tunis in Capsian times—must be considered French archæologists have observed that the ancient Capsian people of North Africa had the custom of extracting one or both of the upper central incisor teeth in youth The cave people of Palestine had the same practice—one which is continued to day by many negro tribes of Africa Yet the early Palestinians were in no sense negroes, the proportions of their limbs are European, not negroid Nor in shape of skull are they negroid—only in the conformation of nose and face Nor does there seem to have been with the succession of cultures any decided change in race, the same small people appear to persist throughout the later cave periods

In the competition to uncover the beginnings of modern civilisation, Palestine has been outstripped by surrounding countries—Egypt, Mesopotamia, and Crete But where their records leave off those of Palestine begin and carry human history into a very remote past In Biblical times Palestine was the pawn of her mighty neighbours Miss Garrod's researches reveal her, even in Pleistocene times, as the scene of contending northern and southern forms of culture

The Prehistoric Races of Africa

At the present time there are being exhibited in the Museum of the Royal College of Surgeons, Lincoln's Inn Fields, the fossilised remains of three ancient types of Africans One of these is the complete skeleton of a man found in the deepest stratum of a cave in the Rift Valley, Kenya Colony, by the East African Archæological Expedition, under the leadership of Mr L S B Leakey Not only are the stone implements shaped by this ancient Kenyan race similar to those wrought by the earliest Cromagnon people of Europe, but there are certain points of resemblance to be seen in the fossil skeleton from the Rift Valley and the tall Cromagnon people of prehistoric France The second specimen on exhibition is an intact skull, in a perfectly fossilised state, which represents a remarkable stage in the evolution of the Bushmen of South Africa For the opportunity of exhibiting this skull in England for the benefit

of students of ancient man the College of Surgeons is indebted to its discoverer, Mr B Peers of South Africa In everyday life Mr Peers is a railway porter, but in his leisure time he is a highly skilled cave explorer Recently, assisted by his son, Mr Peers completed the excavation of a vast cave near Fish Hoek, fifteen miles south of Cape Town, at a depth of ten feet in an undisturbed stratum containing a Palæolithic culture, known to South African archæologists as 'Still Bay', the fossilised skeleton of Fish Hoek man was found The third exhibit, also a fossil skull, was sent home on loan by its discoverer—Prof M R Drennan of the University of Cape Town It represents an 'Australoid' type of man which appeared early in South Africa [2]

Archæologists are now searching all parts of the world to ascertain the country which gave early Europe her Cromagnon pioneers and the stone culture they brought with them—the Aurignacian The discoveries made by the East African expedition under Mr Leakey had an important bearing on this search The culture of the ancient Kenyans —men of the Elmenteita type—had so many points of correspondence with that of the Cromagnon people of France that one must presume extensive borrowings or a derivation from a common source In Cromagnon times the Sahara was not a desert, and Mr Leakey favours the idea that North Africa may have been the homeland we are in search of There is a certain resemblance between the Cromagnon and ancient Kenyan types Both were tall, with long heads and big brains But in the fossil type of Kenya we recognise distinctly African traits in the proportions of limbs and in the structural details of face and head

The ancient Kenyans were certainly not negroes, but in my opinion represent an early Hamitic type * If we suppose these people to have come from northern Africa, then we must also presume that there has been, since their arrival in Kenya, an enormous expansion of Negro peoples, for all the lands between Kenya and Khartoum are occupied by Negro tribes On the other hand, if we follow the trail of Hamitic man as seen in the modern races of Africa, we are guided towards the Straits of Bab-el Mandeb and Arabia In Aurignacian times, Arabia and the deserts of south west Asia were fertile, and it is to these parts of Asia that I looked for the discovery of a source from which both Europe and Africa derived a community of culture and of physical traits

* Mr Leakey dissents from the opinion expressed here He regards Elmenteita man as racially akin to the Combe Capelle and Grimaldi people of Europe.

One of the chief results which have issued from Mr Leakey's researches in Kenya Colony is to give archæologists a time scale for measuring the prehistoric events of Africa His evidence favours the belief—if it does not prove it—that the Elmenteitans of Kenya were the contemporaries of the earliest Cromagnons of France His time scale has given us a clue to the date of other fossil human remains which have been discovered in Africa In 1913 a skeleton was found by Dr Reck at Oldoway, in what is now Tanganyika Territory, embedded in a pleistocene deposit There can be no doubt that the Oldoway man is of the same type as Mr Leakey's ancient Kenyans and belongs to the same period of time Last year the fossil skeleton of a man, described by Dr R Broom,[3] was discovered within a Pleistocene deposit in the northern Transvaal It is probable that the Australoid type now exhibited and described by Prof Drennan may prove to be an offshoot of the same stock The Bantu peoples of Africa have spread into South Africa in comparatively recent centuries, there seems to have been a similar migration of a proto Hamitic people in Pleistocene times

Our search into the prehistory of man is bringing to light strange and unexpected things One of these is the great development of body and brain in the early Palæolithic hunters—the ancestors of the men who brought in the last stone age and the beginnings of our modern civilisation At first sight one is apt to ascribe our modern falling away in size of jaw and brain to the effects of city civilisation That this is not the whole cause is proved by Mr Peers's discovery of the ancestor of the Bushmen of South Africa Modern Bushmen still retain the wild, hunting mode of living Yet their jaws and faces have undergone the same reduction as are seen when we compare the skulls of modern Europeans with those of the ancient Cromagnons The ancestral Bushmen from the Fish Hoek cave had, like the Cromagnon people, an exceptionally large brain—fifteen per cent more than is usual in modern Bushmen The proportion between the face and the brain containing part of the head in the ancestral Bushman was that which is seen in modern children at the age of eight or ten years—where the face is small in proportion to the size of head This is so in all dwarf races of mankind—to which racial category Bushmen belong Prof Drennan, who has published a preliminary account of the Fish Hoek skull, applies to its explanation a law which is gaining assent from anthropologists, namely, that the retention of infantile and youthful traits plays a part in the

evolution of new human races—particularly of the dwarf races of mankind In their structural make-up Bushmen show a strange mixture of prehistoric and ultra-modern traits

The Significance of Peking Man

European anatomists are now in a position to appraise the significance of the fossil remains of man discovered in cave deposits at Chou Kou Tien, 37 miles to the south-west of Peking Prof Davidson Black had placed at their disposal full details of his discoveries, and an examination of the evidence submitted leaves no doubt that China has made a contribution of the highest importance to our knowledge of the evolution of men The discovery has a threefold interest first because of the part of the world in which it has been made Of the prehistoric human types which inhabited the vast continent of Asia we knew nothing until now Secondly, the discovery is important because it gives us the evolutionary stage reached by the ancient Asiatics at a time which is critical in the evolution of humanity—the beginning of the Pleistocene period, the geological period which preceded the dawn of our modern world Former finds had made us acquainted with three beings who belong to this early period—the Java man (*Pithecanthropus*), Piltdown man (*Eoanthropus*), and Heidelberg man (*Palæoanthropus*) Now we have a fourth—Peking man (*Sinanthropus*)—from the distant part of another continent The closest relationship of this new arrival lies with Java man, but it has also resemblances to the pre Neanderthal type of Europe represented by Heidelberg man

The third aspect of this new discovery is the scientific manner in which it has been carried out The most up to date and exact methods have been applied It has been made by a highly skilled band of men enrolled from various nationalities The anatomist, Prof Davidson Black, is a Canadian and a distinguished representative of the British school of anatomy, the geologist and discoverer of the site is Dr J G Andersson, a Swede, the archæologist, Father Teilhard, is French, the director of excavations, Mr W C Pei, is a Chinaman—a member of the Geological Survey of China A system of scientific co-operation has given full, precise, and reliable facts concerning the nature of Peking man and of the times in which he lived

When human remains are found in a natural deposit, disputes are apt to arise as to its geological age It is therefore fortunate that Dr Anderson had dated the geological deposits at Chou Kou Tien before the first trace of man was found, and although at first he was inclined to regard them of late Pliocene age, yet a fuller study of the animal fossils, particularly the fact that the three-toed horse had disappeared and been replaced by the one-toed form, led him to assign the deposits—laid down in limestone caves and fissures at Chou Kou Tien—to an early part of the Pleistocene period—a conclusion confirmed by all later observations Thus we can safely regard Peking man—known to the scientific world as *Sinanthropus pekinensis*—as representing the evolutionary stage reached by the inhabitants of the eastern part of the Old World at the beginning of the Pleistocene period In the cave strata which yielded the human remains no hearths were traced, no sign of fire seen, and no shaped stone or bone which could be regarded as a tool found It would be unsafe to presume, on this negative evidence, that *Sinanthropus* was ignorant of fire and had not discovered the use of tools

The importance of an archæological discovery can be estimated by the extent to which it causes a re orientation of previous knowledge *Sinanthropus* can be fitted into the genealogical trees of man's descent now in common use He sprung from the main human stem near the branches which gave us Java man on one hand and Neanderthal man on the other We have, however, to alter or reconsider our ideas concerning the rate at which the human brain has evolved, or alter our estimate of the duration of the Pleistocene period In Java man the brain was just reaching the threshold of a human standard We regard 950 c c as the lowest possible limit of brain size compatible with the simplest manifestations of human mental life, the Java man was just reaching that size of brain, at the end of the Pliocene or beginning of the Pleistocene period In later Pleistocene times we find large-brained human beings—both of the Neanderthal and of the modern types of man

If we regard the Pleistocene period as having a duration of only 250,000 years, we must presume that the evolution of the human brain has been unexpectedly rapid to convert the Java brain into that of later Pleistocene man Seeing how complex and intricate an organ the human brain is, such a transformation has seemed impossible and hence Java man has come to be regarded not as an ancestral stage, but as end shoot—a survival of an earlier small brained period Now, however, comes the evidence from China In brain size Peking man resembles Java man—only a little

larger—just within the human minimum standard As Prof Davidson Black points out, there is definite evidence on the outside of the skull to make us certain that the brain had moved a stage in a more humanward direction than had that of the Java man Even if we take the highest estimates for the Pleistocene period—a duration of 1½ million years—the changes which would convert the brain of *Sinanthropus* into that of the La Chapelle man would have to be of unexpected rapidity

There is, however, another possibility The men of Java and China may not have represented the highest stage reached in human brain development in early Pleistocene times, elsewhere in the world there might have been a higher form of humanity Peking man lived at the eastern end of the Old World, his contemporary—Piltdown man—lived at the western end of it Piltdown man, in spite of his ape-like canine teeth and his simian chin, makes an infinitely closer approach to the modern type of man than does Peking man The latter has the flattened head which we knew of only in Java man, he has the great bony beam across his forehead which we meet with in Neanderthal man, and many other traits which give him a claim, as Prof Davidson Black has said, to be considered as a possible ancestor of the Neanderthal races The chin of a fossil child (*Sinanthropus*) shows a stage in the transformation of a simian into a human chin The Peking teeth have revealed a mixture of characters—some very ancient and others almost ultra modern On the other hand, Piltdown man has none of the Neanderthalian or Javanese traits, the conformation of his skull bones and of his head herald features of modern man All along I have maintained that Piltdown man was not small-brained, nor is the organisation of his brain of a lowly type Even the lowest estimates of his brain capacity—1200 c c —place him well within the modern category of brain size On the evidence as it stands, England may justly claim to have been leading the world in early Pleistocene times Piltdown man fashioned and used elaborate tools The evidence collected by Mr Reid Moir in the Pliocene deposits of East Anglia also favour England's claim to priority in the evolution of higher humanity

Preglacial Europeans

An account has already been given of the type of man who inhabited Europe before the onset of the last glacial age The fossil remains of one being of this distant period was discovered last year almost at the gates of Rome The Aniene, a stream which joins the Tiber just before that river enters modern Rome, filled its valley in Pleistocene times with deposits, which are made up of sands, clays, and also calcareous ingredients In these deposits are entombed the fossil bones of elephant, rhinoceros, hippopotamus, and horse—of kinds which lived in Italy in the temperate times which preceded the last great period of glaciation In the Aniene deposits are found ancient types of stone implements Six Mousterian stations have been mapped out within 10 miles of Rome, and although it was suspected they were the work of Neanderthal man, not a bone of that fossil type had been found in Italy until May 1929 In that month a labourer digging in a gravel pit in the lower valley of the Aniene, and working at a stratum which lies 20 feet below the present surface level, uncovered a calcareous mass in which was embedded a human skull

Prof Sergio Sergi, director of the Anthropological Institute of the University of Rome, has published a preliminary account of the skull and finds that it is altogether different from that of modern man and is of the Neanderthal type [4] From the photographs of the skull—still partly embedded in its hard matrix—one can see that it is almost a duplicate of the Gibraltar skull discovered in 1848 Like the Gibraltar skull, the specimen now discovered in suburban Rome—the Aniene skull—is that of a woman, both are alike in being small brained—less than 1200 c c —the smallest headed of all known fossil skulls of the Neanderthal type Both have the same long gorilline faces, capacious noses, and strong bony torus above the eye sockets

The Aniene skull is of the same age as the stratum in which it was entombed, and the geological evidence definitely assigns the deposition of the stratum to the long temperate period which preceded the last glaciation Thus Italian anthropologists have proved that in their country, as in France, the Mousterian culture represents the handiwork of Neanderthal man, and that before the last ice age the valley of the Tiber, the site of Rome—and in all likelihood the whole of Italy—was inhabited by human beings of the Neanderthal species The earliest arrivals in Italy of Neanthropic or modern type of man have not yet been found

More instructive still are the German discoveries made in the valley of the Ilm, just above Weimar—the home of Goethe The ancient valley of the Ilm had become filled by deposits, but in a manner quite different from that which produced the Aniene formations The ancient valley of the Ilm had

steep cliff like sides and a flat meadow-covered floor From the sides of the valley issued springs charged with calcareous salts which were slowly deposited as the issuing streams flowed across the flat lands Thus were slowly laid down a series of strata which gradually filled the valley—in some places to a depth of 60 feet The series of strata finish off in the glacial period , they began to form early in the previous interglacial period

These Pleistocene deposits—or rocks—are now worked for building and other purposes , several quarries have been opened in the vicinity of Weimar —at Taubach and at Ehringsdorf The deeper strata, laid down in the temperate period, have yielded many fossil bones of extinct animals, traces of hearths and stone implements of a crude pre-Mousterian kind of workmanship So early as 1895 two teeth were found—at first attributed to an extinct anthropoid ape—but now known to be human In 1914 a lower human jaw was found in the deepest fossiliferous stratum, and then in 1916 that of a child Later, in the autumn of 1925—just before the International Association of Palæontologists visited the pit at Ehringsdorf—a block of rock was blasted from the fossiliferous stratum—at a depth in the quarry of 54 feet—on which was exposed part of a human skull The work of disentangling the skull and its reconstruction proved laborious, so that it was not until late in 1928 that a description of it was published—by Prof F Weidenreich of the University of Heidelberg [5] The skull represents a preglacial inhabitant of Germany The skull—that of a young person—is most capacious, and although possessing the hallmarks of the Neanderthal species, yet differs in several important respects from the later representatives of that extinct race The front part of the skull was not low, but had a high vault The Ehringsdorf jaws, too, show certain primitive features Most remarkable of all is the clear evidence that severe wounds had been inflicted on the forehead of the Ehringsdorf person while the skull was still in a fresh condition The oldest known Neanderthal skull has the marks of Cain on it ! Prof Weidenreich suspects the ancient Ehringsdorf people of cannibalism

The discoveries made in the valleys of the Aniene and Ilm give us a glimpse of the people who lived in Europe during the last interglacial period , they were of the Neanderthal type When this type first appeared in Europe is an open problem , Heidelberg man, who must be attributed to a more remote period, foreshadows the features of Neanderthal man While these discoveries have extended our knowledge of the earlier phases of Neanderthal man, others, particularly that made by Miss Dorothy Garrod at Gibraltar (1925–27), are equally welcome because they throw light on his terminal period The boy whose fossil skull Miss Garrod found in the deposits of a rock shelter on the north front of Gibraltar, although only five years of age, was particularly large brained , if he had lived and his brain had grown at the same rate as in a modern boy, it would have been larger than that of the most capacious Neanderthal skull known The Neanderthal race did not perish for lack of brains

One other important discovery of the fossil remains of man has been made in recent years—one which carries the distribution of the race as far east as the Crimea At a Mousterian site, some fifty miles to the north-east of Sebastopol, Dr Bontch-Osmolooski, Conservator of the Russian Museum, Leningrad, uncovered a fossil skeleton of Neanderthal man A full account of this discovery has not yet been published, but the remains have been examined by Prof Boule of Paris—the leading authority on such matters—and he has confirmed their Neanderthal nature On the other hand, the fossil skeleton unearthed at Podkoumak—north of the Caucasus and to the west of the Caspian—although claimed by its discoverer as being those of Neanderthal man, are certainly not so The jaws and teeth are marked by all the traits of modern man [6]

The present state of our knowledge regarding Neanderthal man is this His remains have been found from Weimar in the north to Malta in the south, from Jersey in the west to the Crimea and Palestine in the east There were local breeds or races In point of time, some of the remains go back to an early phase in the last interglacial period , others are attributed to the first phase of the last glaciation There is evidence that for a long part of the Pleistocene period all the inhabitants of Europe were members of this peculiar Neanderthal race Did they become transformed into modern man or did the race die completely out ? In his Huxley Lecture (1928) Dr Aleš Hrdlička put forward the case for transformation, and some of his arguments have still to be met It seems to me more likely that Neanderthal man and modern man stand to each other not as father and son but as cousins No skull has ever been found which in my opinion can be regarded as transitional or as showing a mixture of characters due to hybridisation of Neanderthal man with modern man No trace of Neanderthal man has been found in any deposit later than those which are marked by the Mousterian culture The termination of the race, in my opinion, was clean cut—such as we meet with when one race rapidly replaces another Where the replacing races came from—the Cromagnons and the Předmostians—certainly remains an unsolved problem, but such evidence as there is seems to trace the first arrivals of Neanthropic man in Europe from Asia rather than from Africa

[1] NATURE, Dec 28, 1929, p 988

[2] An account of this skull, given by Prof Drennan, appears in the *Jour Roy Anthrop Instit.*, vol 59, p 417, 1929

[3] NATURE, Mar 16, 1929, p 415

[4] "La scoperta di un cranio del tipo Neandertal presso Roma *Rivista di Antropologia*, vol 28, p 3, 1929.

[5] *Der Schädelfund von Weimar-Ehringsdorf*, Jena, 1928

[6] *Russian Anthrop Jour*, vol 12, p 92, 1922, *ibid*, vol 16, p. 99, 1926.

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old style of polar exploring in naval vessels under officers ordered to carry out a plan devised by others Since the *Fram*, the best polar work has been done by small parties of trained and well equipped men under a leader following out his own plans by his own methods It is doubtful, as the *Karluk* and the *Maud* have shown, whether Nansen's theory of the ice drift on the Polar Sea is correct, but it was the faith of the man that made him great, not the particular object of his belief

With the present century, Nansen began a series of oceanographical expeditions in the research steamers of the Norwegian Government and some times in his own yacht, during which he attacked special problems of oceanic circulation He took a leading part in the foundation of the International Council for the Study of the Sea in 1900 in co-operation with Sir John Murray When the Council was established, Nansen stood out for having the central laboratory in Norway, and it was sometimes no easy matter to secure smooth working when his views differed sharply from those of other delegates He was always so absolutely certain of the correctness of his own opinions that at times he did rather less than justice to his opponents, but even when argument only stiffened his opposition an appeal to his good nature often brought about a conciliatory compromise

There was in Nansen a singularly engaging *naïveté*, an example of which impressed me so greatly that the spot in Camden Road where he said it remains photographed on my mind "You know," he said, "people say that I am very difficult to get on with, it's quite a mistake, only give me my own way and I'm the easiest fellow in the world to get on with"

While keeping the Norwegian share to the front at the Council meetings Nansen was doing his utmost, in co-operation with Helland Hansen and Hjort, to establish Norwegian supremacy in oceanographical research, and extremely important advances have been made by them in the construction and use of apparatus and in the interpretation of the observations bearing on the circulation of the Norwegian Sea and the North Atlantic as a whole

The political aspirations of his grandfather were rekindled in Nansen's mind when the question of separate consular representation for Norway threatened the union with Sweden, and had personal ambition been a leading motive in him his popularity was such that he could easily have made himself a dictator or a president But he was ambitious only to secure a separate standing for his country, and the peaceful revolution which gave Norway a king of its own was largely Nansen's work He would not enter into contentious politics at home, but took a pride in being the first Norwegian Minister to the Court of St James's, a post he accepted from a sense of duty to his own people, and, despite his appreciation of the personal friendship of King Edward, he resigned with relief as soon as he felt that the new kingdom was fairly on its feet He never cared for ceremony or formality of any kind, and he went back quietly to his professorship of oceanography and to the joy of research in the open sea

Nansen was attracted to the earliest history of the Arctic Seas and sought to link the Vinland of the Sagas with the Fortunate Isles of classic legend, finding satisfaction for the weird and wistful cravings of his mind in blurred legends which he strove, with only partial success, to elucidate in his historical work "In Northern Mists"

For a second time Nansen passed through the Kara Sea, and in a mission for the Russian Government travelled the length and breadth of Siberia in order to report on its resources Then came the War, and the plight of Norway as a helpless neutral, with its shipping paralysed, brought him back to the service of his country as president of the Norwegian Union of Defence In 1917 he went to America and secured by his personal influence an arrangement between Norway and the United States that saved his country from economic strangulation When the War was over, he became one of Norway's representatives on the League of Nations, and all his greatness of heart and mind was thrown into the herculean task of repatriating prisoners of war, many of whom were lost in Russia, saving the remnants of Armenian communities from extermination, organising food supplies for the starving millions of eastern Europe, and using his unrivalled personal popularity as an instrument for fighting the worst evils arising from the War The Nobel Peace Prize was never more worthily bestowed than when Nansen got it in 1923

In 1925 he was elected Lord Rector by the students of St Andrews, and in the following year he gave them a rousing rectorial address, in which he showed them how the spirit of adventure had been the unifying principle of his own life, inspiring his early explorations, his mature researches and the philanthropic missions in which he wore out the last of his tremendous strength He said

"It is our perpetual yearning to overcome difficulties and dangers, to see the hidden things, to penetrate into the regions outside our beaten track, it is the *call of the unknown*, the longing for the Land of Beyond, the divine force deeply rooted in the soul of men which drove the first hunters out into new regions, the mainspring perhaps of our greatest actions—of winged human thought knowing no bounds to its freedom"

The old love of adventure and the passion for research rose in a last flame of enthusiasm when he planned an airship voyage across the north polar basin in the *Graf Zeppelin*, and he had arranged to give a lecture on the subject to a joint meeting of the Royal Meteorological Society and the Aeronautical Society in March last, but the fatal illness baulked his will He died at his home in Lysaker in his sixty ninth year on May 13, 1930 Had he been able to lecture in March he would have tried to convince the sceptical British men of science of the soundness of his plans as he had tried to convince the British admirals in 1893 As in that case he would probably have failed, but had he lived to return successful, the doubting meteorologists, like the doubting admirals before them,

would have been whole hearted in acknowledging that he was right Nansen knew this well, and in one of his last letters to me he wrote "I think I have had some evidence and experience as to the ability of your people to appreciate the achievements of foreigners as much as those of your own people In fact, I never felt that I was a foreigner in England or Scotland" Their sense of kinship with Nansen led his British friends to initiate the *Fram* Preservation Fund while he was still alive, and now they can think of no worthier memorial to the man in his own land than the old ship secured for ever against the tooth of time, like the *Victory* at Portsmouth HUGH ROBERT MILL

DR FRANK R BLAXALL

DR F R BLAXALL, who died on May 24 after a brief illness, was bacteriologist to the Vaccine Department of the Ministry of Health, a post he had held for just over thirty years He established the Government Lymph Institute at Hendon and was responsible during this period for the preparation of the vaccine lymph issued by the Government, and the high reputation which this product deservedly enjoys is largely due to his care and painstaking work

Blaxall received his medical education at University College and Hospital, and obtained his M D (Lond) degree in 1890 with honours in medicine After holding several resident hospital posts, he was appointed lecturer in bacteriology at Westminster Hospital Medical School and in 1896, in collaboration with Dr Colcott Fox, published an important paper on ringworm in London He now came under the influence of the late Sir Armand Ruffer and Prof Allan Macfadyen at the British (now Lister) Institute of Preventive Medicine, and at its old headquarters in Great Russell Street investigated the bacteriology of rheumatoid arthritis, and with Macfadyen published a paper on the thermophilic bacteria—one of the early contributions to this subject In 1896 he commenced an investigation with Dr Monckton Copeman on the inhibitory action of glycerin upon the adventitious micro organisms present in calf lymph, and their results were communicated to the Local Government Board and to the Royal Commission on Vaccination then sitting, the outcome of this work being Blaxall's appointment as bacteriologist to the Vaccine Establishment, then in Lamb's Conduit Street

From thence onwards, Blaxall's work was mainly concentrated upon vaccine lymph, and he published papers on the preparation of calf lymph and on the sterilising action of glycerin and of oil of cloves upon the adventitious microorganisms of vaccine lymph, respecting which he became a recognised authority He served as a member of the Smallpox and Vaccination Commission of the Health Committee of the League of Nations and of the Departmental Committee on Vaccination To lifelong friends and colleagues, Blaxall's loss is indeed a heavy one

R T HEWLETT

WE regret to announce the following deaths

Sir Thomas Walker Arnold, C I E, professor of Arabic in the University of London, English editor of the "Encyclopaedia of Islam", on June 9, aged sixty six years

Prof J B Bradbury, for the past thirty six years Downing professor of medicine in the University of Cambridge, on June 4, aged eighty nine years

The Right Rev G F Browne, formerly Bishop of Stepney and of Bristol, sometime secretary of the Local Examination Syndicate at Cambridge and also (1887–92) Disney professor of archæology in the University, on June 1, aged ninety six years

Major Sir Aston Cooper Key, C B, formerly chief inspector of explosives at the Home Office, on May 28, aged sixty nine years

Dr Kiyoo Nakamura, honorary member of the Royal Meteorological Society, who was director of the Central Meteorological Observatory of Japan from 1895 until 1923, on Jan 3, aged seventy five years

Mr E A Sperry, inventor of the Sperry gyro compass and other gyroscopic appliances, on June 16, at sixty nine years of age

Dr G N Stewart, professor of physiology, Western Reserve University, Cleveland, Ohio, on May 28, at seventy years of age

Mr A F R Wollaston, fellow and tutor of King's College, Cambridge, who served as medical officer and naturalist to the first Mount Everest expedition under Col Howard Bury, on June 3, aged fifty five years

News and Views

SIR ARTHUR KEITH's lectures on recent discoveries of fossil men, delivered at the Royal College of Surgeons during the month of May, and published in an abridged form in this week's Supplement, are likely to provide material for argument among anthropologists for some time to come During the last decade, but especially in the last four or five years, there have been some remarkable accessions to our knowledge of early types of man Palestine, Gibraltar, South Africa, East Africa, and most recently China, each in turn has yielded to the spade new types or new variants of known types Each of these discoveries, it is safe to assume, helps us a stage on the way to final truth, but for the moment, it must be admitted, they add to the complexity of the problem which the anthropologist seeks to solve Sir Arthur Keith's lectures, in a comprehensive survey of the new material, aimed at showing how it could be adapted in building up a scheme of the origin, development, and distribution of early man One of the most interesting of recent discoveries with which he dealt—probably quite new to most of his audience —was that of the remarkable skull from Gardar in south west Greenland, for the description of which he was indebted to Dr Hansen of Copenhagen This skull is not, indeed, one of high antiquity, for it was found in association with the remains of Norsemen in a twelfth century graveyard, but whether it be regarded as atavistic, as Dr Hansen holds, or pathological as Sir Arthur Keith is inclined to think, its

remarkable character, which would place it in a class with the more primitive types of fossil men, invests it with the utmost significance morphologically irrespective of its date It is possible, as Sir Arthur said, that it reproduces a stage of man's evolution which may yet be discovered in a fossil state It is, perhaps, not inapposite to point out that the Neanderthal skull itself was once considered to be pathological

So many points of interest were raised by Sir Arthur Keith's lectures that it is difficult to single out any which call for special mention Not unnaturally his audience was anxious to hear his views on Peking man, now that more detailed information has been so generously laid before English anthropologists by their colleagues in China While his conclusions agree with those already expressed by Dr Davidson Black and Prof Elliot Smith as to the relation of Peking man with *Pithecanthropus erectus*, as he points out, the low estimate of the cranial capacity raises a serious problem as to the rate of growth in the size of the brain in the upward scale of human evolution, if, that is, the dating of Early Pleistocene is correct, as there is every reason to believe The tribute paid to the scientific accuracy with which the investigations attendant on the discovery have been carried out were no more than is deserved If we owe it to the workers in China enumerated by Sir Arthur Keith that we now know what manner of being was early man in eastern Asia, an equal debt is due to Mr Leakey for his work in East Africa which has given us Elmenteita man and to Miss Garrod who at Shukbah and Mount Carmel in Palestine has not only brought to light the most complete sequence of palæolithic cultures yet to be found in that area, but has also revealed to us the skeletal remains of the hitherto unknown people who followed upon the Neanderthal race discovered by Mr Turville Petre in 1925 The interesting inferences which Sir Arthur Keith drew from these and other discoveries upon which he touched may be left to speak for themselves It may be noted, however, how individual discoveries of recognised importance have gained in significance as they have here been brought into relation one with another Europe, once almost the only field for the investigator, no longer bounds the horizon, and the farthest corners of the earth now yield their share towards solving the problem of man's origin, growth, and distribution

ON June 26 occurs the bicentenary of the birth of the French astronomer Charles Messier, who was born in 1730 at Badonviller, in the Department of Meurthe et Moselle Like Lalande, he was attracted to astronomy by the eclipse of the sun of 1748, and at the age of twenty he went to Paris, where Delisle obtained a position for him connected with the marine He was the first in France to observe the eagerly expected comet of Halley, which he saw on Jan 21, 1759, and from that time onwards he spent most of his life searching the heavens for comets and nebulæ Louis XV called him the 'comet ferret', and after the death of Lacaille, Messier was regarded as the foremost practical astronomer in France He was elected a foreign member of the Royal Society in 1764, and obtained a seat in the Paris Academy of Sciences in 1770 He was also a member of the Academies of Berlin and St Petersburg He published a small catalogue of nebulæ in 1771 and another containing 103 entries in 1781, but his work in this direction was soon surpassed by that of Herschel

LIKE his contemporaries Messier lost his pension at the Revolution, and it was only with the assistance of Lalande he was able to continue his observations at Cluny His discovery of a comet in the constellation Serpentarius was made in September 1793 in the midst of the Reign of Terror, and it was the orbit of this comet the unfortunate Bochart de Saron calculated a few days before his death After the Revolution Messier was given a seat in the Institute, and became a member of the Bureau des Longitudes In his eighty sixth year he was attacked by paralysis, and he died in Paris on April 11, 1817, having been blind for some time

STANDARDISATION, however undesirable in some spheres of human activity, has manifest advantages when applied to industrial processes and products A conference which was recently held to examine the requirements of the chemical industries in respect of the formation of a British chemical standardising body, which would do for chemistry what the British Engineering Standards Association is doing for engineering, found itself unanimous in the opinion that such a body should be constituted It cannot be denied that standardisation plays a very important part in securing industrial efficiency and economy, and is, in fact, an essential feature in the rationalisation of industry Even standardisation may be standardised and the view is crystallising that there should be a single organisation embracing all forms In the British Engineering Standards Association there are twelve sections representing different industries, each section enjoying entire autonomy under a central Council within the terms of the charter It has been proposed that the chemical industries should make use of the organisation which already exists, and steps have been taken to change its title to 'The British Standards Association', so that it may be in a position to embrace all forms of standardisation The conference of representatives of organisations connected with chemistry, and of industries utilising chemistry, shares the view that a single organisation is desirable, and has agreed to the appointment of a committee to explore the situation as regards chemical standardisation in collaboration with the British Engineering Standards Association

THE first complete technical account of the notable German Atlantic liner *Bremen* was published on May 24 in a special issue of the *Zeitschrift des Vereines Deutscher Ingenieure*, and from this the *Engineer* is publishing an account of her propelling machinery The first part appeared in the issue for May 30 The *Bremen* has twenty water tube boilers, eleven of which are double ended, delivering steam at 327 lb pressure, absolute, superheated to 350° C The boilers are oil-fired and at sea, for the main and auxiliary machinery,

about 500 tons of steam per hour are required The vessel carries about 1600 tons of oil fuel in her double bottoms and side bunkers The main machinery consists of four sets of turbines, each consisting of a high pressure or intermediate pressure and low pressure turbine driving the four shafts through single reduction gearing The speed of the turbines is 1800 r p m, that of the propellers 180 r p m The total power developed is 92,500 S H P Designed to have a gross tonnage of 51,656 tons and a service speed of 26 25 knots, the *Bremen* has accommodation for 2200 passengers and a crew of 1000

We have received from the Institution of Electrical Engineers a revised supplement of the Institution's wiring regulations, which refers specially to the use of radio receiving sets connected with the public supply mains Copies of these revised regulations can be obtained free of charge from the secretary of the Institution, Savoy Place, W C 2 Emphasis is laid on the danger arising to the ordinary user when an ordinary 'all electric' set can be opened when still connected with the mains, thus exposing 'live' metal When valves have to be inspected or changed, the apparatus should always be previously disconnected from both poles of the supply system Manufacturers ought always to attach a notice to this effect to the case containing the radio apparatus It is not safe to asume that the neutral conductor of a three wire direct current system is always at zero potential Should a fault develop in a main or should a circuit breaker in the link connecting the neutral conductor to earth be opened for testing purposes, there may be a potential difference of 200 volts between all the neutral system and earth The full voltage of the station, between 400 and 500 volts, may also exist between earth and those conductors which normally operate at about 200 volts above or below earth When using crystal sets it is important to keep all the wires of the set well away from any metal objects which might conceivably become alive from contact with the mains The covers of metal switches used for lighting have been known to become alive If there is no risk of the cover making contact through the body with a good earth, the chance of getting a shock is negligible and the fault may never be discovered When, however, a good earth is brought near the cover, there is a real risk of shock

In his Friday evening discourse on unemployment, delivered at the Royal Institution on June 13, Prof Henry Clay said that it is obvious that the interruption and dislocation of established economic relations by the War must affect Great Britain, with its immense international trade, more than any other country The artificial prosperity produced by inflation between 1915 and 1920 also deferred any attempt to make adjustment to conditions that would have changed even if there had been no war, such as the discovery of methods of economising in the use of coal, or the growth of competition in the low-wage eastern countries in the textile industries Three [illegible] can be distinguished as hampering industrialists in their efforts to restore activity First, the fall in world prices, the chief burden of which falls upon the directors and owners of businesses, on whom society relies for initiative and expansion In the second place, the economic system has become more rigid while wholesale prices have fallen 25 per cent since 1924, wage-rates have fallen only 1 or 2 per cent, and Government charges had increased In the third place, the chief fund which fed the growth of industrial enterprise in new directions, and so provided expansion that compensated for lost and declining industries, the profit retained in the business by successful concerns, is now curtailed by high direct taxation Before the War, of every pound applied to the development of industry by the management which had proved its capacity to develop by earning profit, only a shilling or so was taken by the State, now a quarter or a third is taken out of a diminished total The proceeds of this taxation go to pay interest on debt and to finance social services, in this transfer of income from financing industrial development to financing consumption may be found, in part at any rate, an explanation of the activity of the luxury trades in a prolonged period of extreme trade depression

Among the communications made to the Czech Academy of Science in 1927, and now recently published in the *Bulletin International* for that year, is one from Prof Karel Domin dealing with the geology and natural history of the primeval woodlands of Boubín in the Šumava (Bohemian Forest mountains) This virgin forest is a classical region for the study of hercynian vegetation, having remained untouched for a very long period The principal trees are the fir, beech, spruce, and, to a less extent, the maple There is abundant herbaceous undergrowth, especially on the northern and marshy side In the drier part, where deciduous trees predominate, a thick layer of friable humus has formed A characteristic feature of the forest is the presence of spruces with stilt-like roots which have arisen partly through the growth of young plants on the trunks of dead conifers which have subsequently decomposed and partly by the falling away of the soil This is well shown by Prof Domin's set of photogravures illustrating the text A comprehensive list of the flora is given, and it is shown how four distinct types may readily be delimited These are (*a*) marshes and swamps, (*b*) quagmires and damp places in the forest, (*c*) places of medium humidity, and (*d*) alpine and rocky parts All are relatively rich in characteristic vegetation The animal life, however, is to day relatively poor The same issue of the *Bulletin*, which covers the natural and mathematical sciences and medicine, also contains an account of the geology of the Dalmatian island of Silba, by Dr O Matoušek, Prof V Posejpal's recent studies on fluorescence, some further work with the aid of the dropping mercury cathode by Prof J Heyrovský and his students, as well as several biological and histological contributions with illustrations in colours

The second Annual Report of the National Museum of Canada, although its title states that it is 'for 1927', covers the period from April 1, 1927, to

Mar 31, 1928, and was published towards the end of 1929 It indicates that good progress is being made with the various exhibition series of specimens, anthropological, botanical, zoological, and geological, in the Victoria Memorial Museum in Ottawa to which the museum was transferred in 1920 But the space available for the exhibition of collections obviously falls far short of what is necessary, and compares unfavourably with the extent of such provincial museums as that of Ontario The Director estimates that the present building must be increased by more than half as much again, at a cost of nearly a million dollars, to meet the requirements of the next twenty years or so A substantial amount of field work was carried out by the various departments during the period reviewed, perhaps the most important of which, since opportunities become rarer, being the collection of 137 Niska songs, recorded in text form and on the phonograph, and the collection of two adult bulls of the wood buffalo Of the 107 pages of the Report, 72 contain papers of ethnographical and zoological interest, the most unusual being an account of the materia medica, botanical and zoological, of the Bella Coola and other tribes of British Columbia, slugs, we note, should be opened and applied over large cuts, and a draught of a decoction of sea cucumber is a specific against heartburn

THE British Golf Unions Joint Advisory Committee has issued a further interesting number of the *Journal of the Board of Greenkeeping Research* Although the Research Station at St Ives, Bingley, Yorks, has been in existence for less than one year, it has become more and more apparent that its establishment has been fully justified, judging from the rapid growth in the demand for its services Owing to the large amount of advisory work that is necessarily an important feature of the station, it has hitherto been impossible for the present staff to carry out as much actual research work as is desired, and this fundamentally important part of the work can only be developed if the increased interest is accompanied by greater financial support However, much progress has already been made, a number of experimental plots having been laid down and a nursery for stolon production established One of the chief items in the present issue of the *Journal* deals with measures for eradicating worms, details of practical experience being supplied by various golf clubs An account is also given of the formation of putting green turf by vegetative means, use being made of those species of grass which naturally form runners or stolons The action of iron and ammonium sulphates on both grasses and weeds is the subject of a further article One section of the *Journal* is devoted to the publication of typical inquiries and their respective replies This is to be a permanent feature and should do much towards promoting interest and spreading authoritative information on the various problems of greenkeeping

THE ultimate justification of the Empire Cotton Growing Corporation lies in the success it achieves in securing an increase in the production of Empire grown cotton, and in its report for 1930 it is able to show a fivefold increase to 466,544 bales The work of its officers in the various cotton-growing territories is briefly reviewed, but, as this forms the subject of a separate publication (see NATURE, April 12, p 553), the main interest of the present report centres in other subjects, and especially in the work of the Corporation's research station in Trinidad This station was established to prosecute fundamental research " even if its objects might appear to be remote from immediate practical application " Research papers from the station have appeared in the *Annals of Botany* and are republished in the form of *Memoirs* issued by the Corporation Evidence is repeatedly given throughout the report of the difficulty of limiting the field of inquiry to the narrow scope of cotton Sound agricultural practice inevitably involves rotations, and investigations have to be extended to other fields Thus in South Africa it is noted that more attention has been devoted to " the important question of rotation crops " Again, it is useless to produce a crop if the produce cannot be marketed The pioneer work of the Corporation in mechanical transport is now being continued by the Oversea Mechanical Transport Directing Committee, but contact is maintained through the director of the Corporation, who is chairman of that Committee

THE Report for the year 1929 of the National Physical Laboratory is a quarto volume of 300 pages, 230 of which are devoted to particulars of the researches carried out in the physics, electricity, metrology, engineering, aerodynamics, metallurgy, and Froud tank departments respectively The amount of work done for industrial firms exceeds that in any previous year, while the research carried out for boards and committees of the Department of Scientific and Industrial Research which has a direct bearing on industry has been maintained Materials for high pressure steam turbines, for aeroplane engines, for motor springs and chains, and lubricating oils have all been under investigation A new building for the Physics Department is nearing completion and the construction of a compressed air tunnel is about to be commenced New buildings for acoustics and for photometry are under contemplation, as well as a number of smaller additions rendered necessary by the increase of the demand for work by industrial firms Nearly ninety official and twenty unofficial papers have been published by the staff in scientific and technical periodicals during the year, an output which affords ample evidence of their activity

THE complete annual report of the Board of Regents of the Smithsonian Institution for the year ending June 30, 1928, has recently been issued This volume, as is customary, includes a complete statement of the activities of the Institution, and in addition, a valuable appendix occupying 585 pages or about four fifths of the volume, containing articles by authorities on scientific topics of current interest Some of these are reprints of addresses which have already appeared in whole or in part in our columns, for example, Sir James Jeans's Trueman Wood Lecture before the Royal Society of Arts on " The Wider Aspects of Cosmogony ", the British Associa-

tion address at Leeds by Prof R A Millikan, which appeared as a supplement to NATURE entitled "New Results on Cosmic Rays", by Prof R A Millikan and Dr G H Cameron, Dr R N Rudmose Brown's presidential address at Leeds to Section E (Geography) of the British Association on "Some Problems of Polar Geography" There are also contributions by Prof J W Gregory on "Water Divining", being his presidential address in 1927 to the British Water works Association, Public Works, Roads, and Transport Congress, and the Arrhenius Memorial Lecture delivered before the Chemical Society by Sir James Walker on May 10, 1928

VOLUME 18 of the Travaux et Mémoires of the Bureau International des Poids et Mesures (Paris Gauthier Villars et Cie, 1930) contains nearly 300 pages and gives accounts of the meetings of the international committee since 1921 The director, M Guillaume, gives a short history of the progress of the metric system and of the search for the most satisfactory materials for standards, and contributes a memoir on the mercury in glass thermometer The old 'verre dur' used by Tonnelot and Baudin in the 'eighties is no longer made and this has entailed a search for a glass equally good It is now found that a thermometer with a bulb of Jena glass 16 M and a stem of a green glass containing a small percentage of lead is the most satisfactory M Volet shows that the observations of Chappuis on the boiling point of water between 555 mm and 825 mm of mercury require for their accurate representation a trinominal in p M Perard gives an account of the interference methods used for the study and comparison of industrial gauges and similar end standards The volume concludes with an account of the celebration of the jubilee of the foundation of the Bureau, held Oct 5, 1927, when addresses were given by MM Emile Picard, C E Guillaume, and Maurice Bokanowski

THE Annual Report of the United States National Museum, Washington, D C, which corresponds approximately to the British Museum (Natural History), to June 1929, states that at the close of the fiscal year the staff consisted of 47 professional and scientific employees, 42 sub professional employees, 41 clerical, administrative, and fiscal workers, and 181 in the custodial service—311 in all In addition, some 54 other specialists hold honorary appointments in the Museum, many of whom devoted much time to work on the national collections Better conditions of pay have been arranged for the staff, the greater part of the increase of 97,064 dollars in the annual grant having been applied to much needed adjustment in the salary scales, and one gratifying result has been that the personnel has tended to become more stable The number of specimens added to the collections continues to increase, and a survey of the materials in the various departments brings the total number of specimens to 12,029,469, but even this survey is not complete Biology alone contains 8,848,367 specimens In view of this increase, it is not surprising to find that the Director complains of congestion in the present space occupied by the Museum collections, in spite of directive effort to select for preservation only the objects that must be kept and to eliminate material that is not permanently desired

A RECENT addition to the valuable catalogues of the collections of objects in the U S National Museum deals with objects of religious ceremonial It is uniform with the catalogue of objects used in the production of fire and light issued not long ago, and forms *Bulletin* No 148 of the U S Museum The author is the late Dr Immanuel Casanowicz, who died in 1928, after many years' service as assistant curator of the Division of Old World Archæology The catalogue covers the Jewish, Christian, Eastern Church, Mohammedan, Hindu, Buddhist, Parsee, and Shinto religions It is well illustrated by a large number of plates figuring ritual objects and implements, medals, crucifixes, ikons, statues of the Buddha, sacrificial accessories and the like which are in the museum Not merely are the objects of the collections described, but notes on ceremonial and function are added which raise the work from a mere catalogue to the status of a brief introductory manual to the ritualistic side of each religion in turn Such catalogues of classified objects cannot compare with the more comprehensive catalogues of the ethnographical and archæological collections in the British Museum, either in appearance or in the nature of their contents, but at the same time it must be recognised that they are of the greatest value to the student of the various branches of culture, as they bring the material ready to his hand in convenient association

THE two handsome volumes, 1200 pages in all, constituting the annual report of the Director of Veterinary Services, Onderstepoort, Pretoria (Union of South Africa Department of Agriculture Pretoria Government Printer, 1929 10*s* each vol), contain details of a number of important and interesting researches on protozoal, virus, and bacterial diseases of animals, parasitology, pathology, poisonous plants, sterility of cows, and mineral deficiency of the Veld Further outbreaks of botulism among animals and birds are recorded (E M Robinson) A new schistosome, *S mattheei*, from sheep is described (F Veglia and P L le Roux) Skin cancer of the Angora goat in South Africa is dealt with in an exhaustive paper by A D Thomas, who remarks that tumours in the lower animals are not a rarity in South Africa The phosphorus deficiency of the Veld soil and pasture is indirectly the cause of a disease, lamsiekte (parabotulism), of cattle, and is preventible by supplying rations of bonemeal, as described in a previous report (1927) It is now found that the bonemeal has also a remarkable influence in increasing the fertility of the cows in the district as well as causing more regular breeding (P J du Toit and J H R Bisschop) The report is well produced and profusely illustrated with excellent plates, and is worthy of a better binding

SIR WILLIAM BRAGG, director of the Royal Institution and of the Davy Faraday Research Laboratory, has been elected a corresponding member of the Vienna Academy of Sciences

THE third Imperial Entomological Conference was opened in London on June 17 by Lord Buxton The meetings of the Conference are being held in the rooms of the Entomological Society of London, 41 Queen's Gate, S W 7 Among the subjects of discussion are Organisation of entomological departments, entomological work among backward races, tsetse control, control of insects by cultural methods, locusts, biological control of insects, control of weeds by insects, and control of orchard pests In connexion with the Conference, the Imperial Bureau of Entomology has issued a list of entomologists employed in the British Empire, and a summary of data relating to economic entomology in the Empire

A COMMITTEE has been appointed by the Secretary of State for the Colonies, in consultation with the Secretary of State for India and the Forestry Commissioners, to consider and report on the training of candidates and probationers for appointment as forest officers in the government service The members of the Committee are Sir James Irvine, principal of St Andrews University (Chairman), Mr G E S Cubitt late Conservator of Forests, Malaya, Sir Thomas Middleton, Development Commissioner, Mr R L Robinson, vice chairman of the Forestry Commission and Technical Commissioner, Mr F W H Smith, assistant secretary India Office, Mr C G Trevor, late vice principal and professor of forestry, Dehra Dun, India, Major R D Furse private secretary (Appointments) to the Secretary of State for the Colonies Mr G H Creasy (Colonial Office) has been appointed secretary to the Committee

THE Medical Research Council announces that on behalf of the Rockefeller Foundation it has made the following awards of travelling fellowships for the academic year 1930–31 These fellowships are awarded to graduates who have had some training in research work either in the primary sciences of medicine or in clinical medicine and surgery, and are likely to profit by a period of work at a chosen centre in America or, in special cases, in Europe, before taking up positions for higher teaching or research in the British Isles Mr R C Brock, Guy's Hospital, London, Dr F B Byrom, London Hospital, Mr D Curran, Hospital for Epilepsy and Paralysis, Maida Vale, London, Dr A A Moncrieff, Hospital for Sick Children, Great Ormond Street, London, Mr A S Paterson, Royal Glasgow Mental Hospital, Dr C C Ungley, Royal Victoria Infirmary, Newcastle on Tyne Dr Moncrieff's fellowship is tenable at Hamburg, the others at centres in the United States Mr Brock and Dr Curran have been appointed on modified conditions while receiving emoluments from other sources

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A lecturer in education in the Department of Education of the University of Birmingham—The Secretary, University, Birmingham (June 24) A principal of the Northern Polytechnic—The Clerk, Northern Polytechnic, Holloway, N 7 (June 27) A horticultural superintendent under the County Council of the Isle of Ely —The Director of Education, Education Offices, March (June 28) A lecturer in rural science at the East Anglian Institute of Agriculture, Chelmsford —The Clerk of the Essex County Council, Shire Hall, Chelmsford (June 30) A district agricultural organiser and lecturer in dairy husbandry at the East Anglian Institute of Agriculture, Chelmsford—The Clerk of the Essex County Council, Shire Hall, Chelmsford (June 30) An assistant lecturer in mathematics in the University of Leeds The Registrar, The University, Leeds (June 30) An assistant lecturer in physics at the Cardiff Technical College—The Principal, Technical College Cardiff (July 2) A professor of physics in the University College of South Wales and Monmouthshire—The Registrar, University College, Cardiff (July 4) A professor of chemistry and head of the department and a professor of physics and head of the department of the Muslim University, Aligarh, U P, India—Vice Chancellor S R Masood, c/o Box 10, c/o NATURE Office (July 4) A professor of mechanical engineering at the Bengal Engineering College, Sibpur, Bengal—The Secretary to the High Commissioner for India, General Department, India House Aldwych, W C 2 (July 5) A lecturer in mining at the Sunderland Technical College—The Chief Education Officer, 15 John Street, Sunderland (July 5) A lecturer in education in the University of Durham—The Secretary of the Joint Board, University Offices, North Bailey, Durham (July 7) Chief lecturers in, respectively, mechanical engineering electrical engineering and metallurgy, at the Rotherham Technical Institute—The Director of Education, Education Offices, Rotherham (July 8) A demonstrator of physics at Guy's Hospital Medical School The Dean, Guy's Hospital Medical School, London Bridge, S E 1 (July 10) A clinical research worker in mental deficiency under the Medical Research Council, the Governing Body of the Darwin Trust, and the Committee of the Royal Eastern Counties Institution for the Mentally Defective at Colchester—Miss Darwin, The Orchard, Huntingdon Road, Cambridge (July 13) A professor of zoology in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W C 2 (Aug 31) A senior lectureship in education in the University of Liverpool—The Registrar, The University, Liverpool (Sept 30) A lecturer in education at the Brighton Municipal Training College for Women—The Secretary, 54 Old Steine, Brighton A graduate teacher for mathematics and engineering drawing at the Cumberland Technical College, Workington — The Principal, Cumberland Technical College, Workington Masters for, respectively, mathematics, and mathematics and physical science, under the Education Department of Southern Rhodesia, for European Schools — The High Commissioner for Southern Rhodesia, Crown House, Aldwych, W C 2 An aero examiner (metallurgist) under the Aeronautical Inspection Directorate of the Air Ministry —The Secretary (I E 2), Air Ministry, W C 2 An assistant in the department of geography of University College, London—The Secretary, University College, Gower Street W C 1

Research Items.

'Bar-lip' Pottery from Essex and Alderney.—In *Man* for June, Mr. T. D. Kendrick figures and describes two fragments of pottery recently acquired by the British Museum, one from Barkingside, Essex, presented by Mr. Hazzledine Warren and Mr. Ryde, and one from the late-Roman fort known as the "Nunnery," Longy Bay, Alderney, presented by Lieut. C. S. Durtnell. The first was part of a bowl about 20 cm. in diameter which probably had a round base. It was a wide mouthed pot with pinched-in neck and lip slightly everted, but its most remarkable feature was that at its rim there were three large protruding spouts across which the rim of the pot is carried in the form of a deep and thickened bar. The bowl is hand made, clumsily modelled, of a coarse gritty ware and deep smoky brown on both faces. The Alderney specimen has a single spout of much the same size as those on the Essex bowl, but the potting is of a much higher character. In the Museum fur Vaterländischen Alterthumer at Kiel are fragments of at least three bowls of the same type, all coming from Haithabu (Hedeby) at the east end of the Danewirke, a famous mart in Viking days. This gives a date of from ninth to twelfth century for the Kiel specimens, and as the Vikings copied Frankish models, the protype must be sought in Frankish pottery. A jug from Aubres, near Nyons, in the Drôme department of France, shows where the Vikings may have seen something of the sort. The clumsy bowl from Barkingside may be an early attempt, perhaps of the ninth or tenth century, introduced by Vikings from Frisia, while the Alderney fragment may be later, possibly eleventh century introduced to the island by Rollo's men. Dr. Cyril Fox has pointed out to the author that there are similar fragments in the Cambridge Museum for Archæology and Ethnology from Abington Piggots, Cambridgshire.

Totemism in Eastern Australia.—A systematic study of the social organisation of Australian tribes has now been instituted by the Australian National Research Council by means of funds provided by the Rockefeller Foundation. As a result, our knowledge of Australian totemism and related phenomena is being greatly extended. Views hitherto current relating to the system of Arunta totemism as described by Spencer and Gillen are being re-examined. Prof. Radcliffe Brown contributes to vol. 59, pt. 2 of the *Journal of the Royal Anthropological Institute* the results of an investigation among a number of tribes in the northern part of New South Wales in which the special problem was the relation between man and Nature in myth and ritual. It was found that each of the tribes in question performed rites for the increase of natural species. Each tribe is organised into hordes—small exogamous local patrilineal clans. The characteristic feature of the cult among them is that there are several sacred spots belonging to each horde at which increase rites are performed. These spots are marked usually by a water hole, and sacred trees or peculiar stones or rocks. Each is associated with some particular natural species and the rites are simple, usually consisting of stirring up the water-hole, throwing mud at the trees, and so forth. There exists also a system of myths associating the sacred spot with the acts of mythical beings. A cult conforming to this general pattern is widespread in Australia, but with local variations, of which Aranda totemism with its conception of reincarnation is one. It is possible that among the Aranda the association between the increase rite and the horde may be found still to exist. It is concluded that the problem of totemism can only be solved when we have a satisfactorily wide theory of the relation in myth and ritual between man and Nature in the less developed societies both totemic and non-totemic.

Alcoholism.—The May issue of the *Bulletin of Hygiene* contains a review of recent literature on alcoholism by Dr. J. D. Rolleston. Previous contributions to this subject by Dr. Rolleston during the last two years have been noted in Nature of Aug. 25, 1928, p. 285; April 20, 1929, p. 615; Aug. 10, 1929, p. 245. The present review deals with its historical aspects, its prevalence in various countries, with special reference to the cocktail habit and methyl alchol drinking, experimental work, alcohol and aviation, alcohol and economics, the association of alcoholism with other morbid conditions, the decline of alcohol in therapeutics, the diagnosis of alcoholism by colorimetric methods, alcohol and longevity, legislation and treatment. A bibliography of thirty-six references to the literature of nine different countries is given.

Biochemical Aspect of the Recapitulation Theory.—The text of a very interesting paper under this title by Dr. Joseph Needham, in *Biological Reviews*, vol. 5, April 1930, may be said to be the observation that the chick embryo for a short time in its early development excretes 90 per cent. of its nitrogen as ammonia, then for a short time 90 per cent. as urea, and finally 90 per cent. as uric acid. From the recapitulatory point of view this is very suggestive since marine invertebrates excrete their waste nitrogen as ammonia, fishes and amphibia as urea, and sauria and birds mainly as uric acid. Needham brings into line with these observations a number of other biochemical data; for example, the appearance of hormones in the developing embryo, none being present in the unfertilised egg, whilst they are also notoriously deficient in the invertebrates. Needham argues that recapitulation may be regarded as fundamentally the result of the necessary passage from simplicity to complexity, from low to high organisation, which is entailed by the metazoal sexual system of reproduction, with its single egg cell.

Vole Cycles in Great Britain.—In view of the enormous destruction which has occasionally been caused in Great Britain owing to abnormal plagues of voles or short-tailed field mice (*Microtus agrestis* and *hirtus*), the importance of an understanding of their bionomics is of obvious importance. For some time A. D. Middleton has been endeavouring to collect from foresters, farmers, and naturalists, records of the annual fluctuations of this pest, and his investigation shows that there is a well marked periodicity in numbers (*Jour. Ecology*, vol. 18, p. 156). Maximum numbers occur approximately every fourth year, and the graph which illustrates Mr. Middleton's paper shows that unusually large numbers were present in 1922 and 1926. On these facts a vole plague (possibly on a smaller scale) may be looked for in the autumn of the present year, but there is a possibility that the graph may be misleading as regards intensity, since reporters are more likely to retain vivid memories of the more recent events. Steps are being taken, however, to place future records on a more reliable statistical basis. The causes of the cycle are not yet fully understood, but there is evidence that, as in so many other rodent plagues, disease is a controlling factor in some instances, although climatic factors are also involved.

Hair of the Fossil Ground-Sloth (Nototherium).—A reprint received from Leon Augustus Hausman (the source of which unfortunately is not indicated) gives an interesting account of a peculiar feature of the hair of the fossil ground sloth (*Nototherium shastense*) recently set up in the Peabody Museum. Only one sort of hair could be seen, corresponding to the over hair of modern mammals; there was no trace of an undercoat of fine hair. The shafts of the hair showed the typical structures, medulla, cortex, cuticle, and pigment granules, and the cuticular scales could easily be distinguished. Where the scales were present, there occurred on the surface of the shaft minute oval bodies which suggested the algal cells present on the hairs of modern South American sloths. Nothing like them has been seen on the hairs of several hundred mammal species examined, and the author, though he does not commit himself, leans to the opinion that they represent an algal association on the hair shafts. We take this opportunity of directing the attention of readers to an excellent and fully illustrated article by the same author on "recent studies of hair structure relationships" in the *Scientific Monthly* for March.

Control of Greenhouse Red Spider.—A new leaflet (No. 99) has been issued recently by the Ministry of Agriculture on the subject of the greenhouse red spider. This extremely small, but notoriously injurious pest attacks many glasshouse plants, and since it is able to increase with extraordinary rapidity, readily becomes a serious menace to growers. Cucumbers and tomatoes are chiefly affected, the plants becoming hardened and stunted in growth, and the leaves injured. Among crops in the open, hops and strawberries are particularly liable to damage. The attack usually begins in the spring and continues during the summer, when the many successive generations feed and lay their eggs upon the under sides of the leaves. In October the female, after fertilisation, changes from a greenish black to a brilliant red colour. In this condition the mites leave the plants, preparatory to hibernation, become gregarious, and live in a common web. Although they do not feed in the winter, they only become inactive at temperatures far below freezing point. As regards methods of control, fumigation with naphthalene is extensively used for cucumbers, but is not suitable for tomatoes or carnations. Spraying with petroleum emulsions is also an effective measure against attacks on cucumbers or tomatoes, but should not be used for carnations or peaches. For the two latter crops, liver of sulphur is particularly suitable, but for safety spraying must be done in the evening or during dull weather. Other remedial methods are also quoted, and details of the quantities and the conditions under which the various fumigants and sprays are used to best advantage are supplied.

Species and Races in the Salmonidæ.—The work of Dr. H. Henking on salmon, sea trout, and trout is of great interest. In his memoir "Untersuchungen an Salmonidae mit besonderer Berucksichtigung der Art- und Rassenfragen. Teil I." (Conseil Permanent International pour l'Exploration de la Mer. *Rapports et Procès-Verbaux des Réunions*. Volume 61, November 1929) he describes his experiments dealing with racial studies which were undertaken at the instigation of the Limnological Committee of the Council at its meeting in June 1928. In addition to the experimental work a large amount of material has been examined which was collected for many years by Germany, chiefly from the Pomeranian coast, but also from the west coast of Schleswig-Holstein and some samples from the North Sea. As is well known, the salmon and the sea trout pass their life between sea and fresh water, whilst the trout lives almost wholly in fresh water. It is shown in this report that pond trout, if transferred to slightly salt water, such as the Baltic, grow so like the sea trout that it is almost impossible to distinguish them, although there is a tendency at first to return to the fresh water. When established in the Baltic, however, the fish grew to a large size. The conclusions are that the salmon is a distinct species, the trout and sea trout together forming another species, although the two latter usually can be easily distinguished by their size and habits of life. Salmon and sea trout are sometimes difficult to separate, but Dr. A. C. Johansen has shown that there are differences in the gill rakers. Such differences, together with those in the vomer and the os lingue, are here shown to be good distinguishing characters. Hybrids can be produced artificially between salmon and trout, salmon and sea trout or trout and sea trout, but so far no natural hybrids are positively known.

Cocksfoot Grass.—The result of a four years' field trial between indigenous, New Zealand, Danish, and French cocksfoot grass is the subject of an article by Prof. Stapledon in the *Welsh Journal of Agriculture*, vol. 6. New Zealand and indigenous strains are closely allied and differ greatly from the Danish and French types. Although the latter start growth earlier in the spring, and may give the better yield in the first two harvests, the New Zealand and indigenous strains invariably produce the best aftermath and are decidedly the most persistent; further, they are more winter green and their sward is less woody. The leaf to stem ratio in the shoot is higher in the New Zealand and indigenous species than in the Danish and French, and since the heaviest response to manuring, from the point of view of yield, is obtained when the bias is in this direction, it is specially worth while to apply liberal dressings of fertilisers to those leafy strains of the grass. The effect of different cutting and manurial treatment on tiller and root development of cocksfoot is also described in the same volume, both pasture and hay *cum* aftermath systems being considered. As regards yield, the plants cut as hay and aftermath gave the best results, but plants cut to 6 in. at fairly frequent intervals considerably outyielded and also showed greater root development than those cut to ground level. This would point to the necessity of avoiding close and continuous grazing if the productivity of a pasture is to be maintained. Nitrogen applied as nitro chalk in heavy incremental dressings had a more pronounced effect on hay *cum* aftermath than on pasture, but all systems of cutting showed a response to nitrogen. A continued plucking of inflorescences was found to increase tiller and root development. The soundness of the practice of running the mowing machine over pastures (at intervals if necessary) to remove excess of flowering shoots is therefore upheld.

Giant Senecios on Kilimanjaro.—Following the recent British Association visit to South and East Africa, accounts of vegetation from interesting localities continue to appear from the pens of botanists fortunate enough to take part in this tour. In the *Kew Bulletin*, No. 3, 1930, Mr. A. D. Cotton has an interesting account of earlier botanical exploration of Kilimanjaro. This mountain, with its volcanic crater, is likely to be more accessible in future to British visitors who may approach it, as did Mr. A. D. Cotton (and Dr. A. S. Hitchcock of the Smithsonian Institution) from the direction of Amani. The two travellers were able to break their rail journey from Amani to Nairobi at Moshi, the bi-weekly train service per

mitting time for a considerable ascent of the mountain The recently opened Kibo Hotel at Marangu provides a suitable base of operations on the south side of the mountain and the proprietor of the hotel owns two conveniently placed resthouses on the slopes at altitudes of 8500 feet and 11,500 feet respectively In four days the two travellers were able to make a comparatively leisurely ascent, Dr Hitchcock collecting up to 14,000 feet altitude, and the list of plants brought back by Mr Cotton shows that a considerable amount of valuable work could be carried out in this period Mr Cotton's account is illustrated by some excellent photographs, taken by Dr Hitchcock, of the arborescent Senecios on the rocky slopes One of these is described as a new species, *S Cottonii* Hutch and Taylor It was not recognised as new until brought back to Kew, so that its altitudinal limits are not clearly known, but it probably grows at higher altitudes than *S Johnstonii*, which grows on the same mountains and is named after Sir Harry Johnston

Observations by Pilot Balloons —The Swedish Meteorological and Hydrographical Office has collected together as part 10 of *Arsbok* for 1928 a number of meteorological observations taken at high altitudes These include aeroplane observations at the aviation stations of Malmslätt and Ljungbyhed throughout the year, and reading by pilot balloons at Malmo and Göteborg for the great part of the year, and at Stockholm, Östersund, and Abisko for the whole year Most of the observations were made below four thousand metres, but a few were made at several stations above five thousand metres At most stations the observations, which are printed in full, were taken almost every day in the month They include temperature, humidity, pressure, wind and cloud

Superconductors —Measurements made at the Leyden Cryogenic Laboratory during the past ten years have established the fact that the following pure metals become superconducting at the absolute temperatures given—lead 7 2°, mercury 4 2°, white tin 3 8°, indium 3 4°, thallium 2 5°, and gallium 1 1° Measurements have been made more recently by Profs de Haas, van Aubel, and Voogd on the resistivities of alloys of these metals with each other and with other metals not showing superconductivity at temperatures at present attainable Their results are given in Leyden *Communications* 193, 197, and 199 When thallium is alloyed with bismuth or tin with antimony superconductivity occurs at a higher temperature than it does in the pure metal, but when tin is alloyed with silver or copper the alloy is not superconducting On the other hand, an alloy of 4 per cent bismuth in gold becomes superconducting at 1 9° although neither constituent is superconducting In the *Transactions of the Royal Society of Canada* for April, Prof J C McLennan and Messrs Allen and Wilhelm show that by the addition of bismuth to lead or to lead tin alloys the temperature at which superconductivity begins may be raised, for example, to 8 8°, that is 1 6° above that for pure lead

Spectroscopy of the Night Sky —The April number of the *Canadian Journal of Research* contains a paper by Prof J C McLennan and Mr H J C Ireton, describing a special spectrograph for investigation of light from the night sky The instrument has not the usual symmetrical form, the collimator lens being an achromatic cemented doublet of 50 mm aperture and 56 cm focus, and the camera lens either a single aspherical lens designed to give the maximum concentration of light for the mercury green line, or a four component F/1 lens of 50 mm focus, designed to give good focus of the entire spectrum on a flat but tilted plate The instrument is mounted so that the collimator can be readily directed to any part of the sky Some tests which have been made at various stations in Canada and England, using the compound camera lens, have shown that the green line (5577 A) from the non polar aurora can be photographed in as short a time as ten minutes under favorable conditions, so that it will be now easily possible to follow the change in intensity of this radiation throughout the night, as well as to study the radiation coming from different parts of the polar aurora With exposures of between one quarter and one half of an hour, with a slit 1 mm wide, six lines were obtained in the spectrum of the light from the polar aurora, in addition to the green line and the two nitrogen bands at 3914 A and 4278 A

Crystal Structure of Normal Paraffins —Dr A Müller has contributed a paper to the May number of the *Proceedings of the Royal Society* on the crystal structure of the normal paraffins, based on an X ray investigation of a number between C_5H_{12} and $C_{30}H_{62}$ Between liquid air temperature and the melting point, the coefficient of expansion has been found to be different for each of the two axes perpendicular to the carbon chain, and the expansion in the last direction is too small to be measured under the conditions of experiment The higher hydrocarbons have been shown to crystallise in a form which is the same for odd and even members, differences between the behaviour of the two types of molecules first becoming apparent when the carbon content is decreased About $C_{20}H_{42}$, two alternative structures are found for each compound in the even series, whilst in the odd series the transition takes place between $C_{11}H_{24}$ and C_9H_{20} An observation of special interest is that the substances tend to form layer structures in the immediate neighbourhood of the melting point, the two sets of orientations of the cross sections of the molecules appear to give place to a more or less definite single orientation, and it is suggested by Dr Muller that it may prove possible to influence the balance of the internal forces in the crystal in a similar way by an external electric or magnetic field in this region

Photolysis of Aqueous Hydrogen Peroxide —The April number of the *Journal of the Chemical Society* contains two papers on the above subject by Allmand and Style The results were found to be very complicated The velocity of decomposition was found to vary with the square root of the light intensity, an unexpected result which suggests the formation of a catalyst by the action of light The effect of concentration was also unexpected, since the quantum efficiency increased steadily as the solution was diluted, and the thermal velocity also increased over the greater part of the concentration range covered In some cases the quantum efficiency passed through a maximum with constant intensity as the concentration of peroxide increased The value of the quantum efficiency indicated a catalytic chain with a life of about 1 sec The theoretical bearings of these results are discussed, including the observation that the temperature coefficients of photolysis decreased with increasing frequency, which suggests that they are concerned with the primary process only It is suggested that, since only a very small proportion of the absorbing molecules react after absorption, the reaction chains must be very long The square root relation suggests that the catalyst, of mean life of 1 sec , may consist either of OH groups or oxygen atoms, produced in the liquid phase It is pointed out that a complete theoretical interpretation of the results cannot be given at present

Photo-Electric Cells

THE recent discussion on magnetism (see NATURE, June 7, p 874) afforded an example of a symposium on a subject academic and in some respects aloof from the problems of everyday life The discussion on June 4 and 5, organised jointly by the Physical and the Optical Societies is at the opposite pole Although the photo electric effect both raises and resolves many recondite problems in modern physics, its applications may touch modern life at points so far distant as photo therapy and greyhound racing, and it was in great measure on applications that the interest of the discussion centred

That a metal plate, exposed to the light from an arc, acquires a positive potential—indicating therefore the emission of electrons—was observed so long ago as 1888 by Hallwachs and facts of fundamental importance were rapidly accumulated by Elster and Geitel, who demonstrated in particular that while ultra violet light was the effective agent in establishing the positive potential of an ordinary metallic plate, the alkali metals, sodium potassium, and rubidium, were sensitive to rays from the luminous portion of the spectrum

Einstein in 1905, using the hypothesis of light quanta, showed that the maximum kinetic energy of electronic emission was a linear function of the frequency (ν) of the light employed In fact,

$$\tfrac{1}{2}mv^2 = h(\nu - \nu_0),$$

where $h\nu_0$ is the 'electron affinity', and is a measure of the loss of energy suffered by the electron in escaping from the interior of the atom This equation, which is the basis of one of the most accurate methods for the determination of Planck's constant h, suggests that there is a light frequency ν_0 characteristic of the metal on which the light falls, and such that, if the incident light has a frequency less than ν_0, no electron emission takes place

The fact that a metal such as potassium is sensitive to ordinary light at once suggests its use in a cell in which the electronic current so produced may be measured, and its variation studied with variation of the incident light Again the photo electric current may be amplified by valve circuits used outside the cell, or may be magnified within the cell by filling the cell with gas, applying a relatively large electric field and so producing ionisation by collision

Obviously, constructional problems of no small difficulty at once present themselves, and, these problems solved, with the many applications of photo electric cells, the question of standardisation arises It is, for example, a matter of primary importance that the gas filled cells now so largely used in connexion with talking films should be standardised as regards size, voltage, and terminal arrangements This and allied matters are discussed in detail by Dr Norman Campbell, while the problems of manufacture are very fully described in connexion with the thalofide cell (a cell sensitive to the infra red, in which the active substance is oxidised thallium sulphide), barium photo electric cells, sodium, and selenium cells

Theoretical problems did not bulk largely in the discussion Dr Campbell described a theory of selective emission in which it is suggested that in selectively emitting surfaces an electro negative element is universally present Further, following a clue given by the recent work of Fowler and Wilson, the conditions for selective transmission are assumed to be fulfilled if the potential changes at the transmitting surface are such that a 'valley' of potential is formed between two 'peaks' so situated that the waves associated with the electrons are capable of forming stationary waves between the sides of the valley Two investigations of valve amplification of photo electric currents complete the more important theoretical studies read during the discussion

The papers presented may conveniently be grouped under the main headings, history and development, theory, manufacture, and applications Naturally, the application of widest interest is to photometry, and it is not surprising that eleven out of the twenty seven papers presented deal with various aspects of photometry The problem is not easy It has been well remarked of the human eye that "an instrument that will work with almost equal precision in illuminations differing in a ratio of ten thousand to one is not likely to distinguish easily small differences of illumination" Photo electric methods are considerably more precise but it must be carefully considered what that precision measures, in view of the fact that two lights, judged by the eye to be equal, will not be rated as equal by a photo electric cell unless they have the same quality, and further it may be debated whether high precision is worth while, when we remember that in problems of vision the eye is the final standard However that may be, photo electric photometry is coming into wide use, and the papers dealing with precision measurements in photometry, the comparison of lights of very small intensity, the photo electric measurement of daylight and of under sea illumination photo electric photometry in relation to photo therapy, and spectro photometry, form a most helpful contribution to the discussion of this important branch of the subject

In the section dealing with measurements, attention may be directed to a description, by Mr Eric Moss of a very compact null electrostatic method involving the use of the Lindemann electrometer, for the absolute measurement of the photo electric current

A particularly neat application of the photo electric cell to the measurement of small angles was described and demonstrated by Dr Perfect, in which an image of a narrow slit is focused on the razor sharp edge of a steel prism and is thus divided into two components, the relative intensity of which varies with the position of the image of the slit This relative intensity is measured by allowing the components to 'flicker' on a photo electric cell The amplified alternating photo electric current is rectified by a commutator, and its magnitude measures the relative intensity required In the experiment as shown displacements of the beam of light which forms the image of the slit are compensated by means of a hollow prism containing air, the internal pressure of which may be varied It is possible by this arrangement to measure angles of less than 15″ with a probable error of the order of 0 05″

The discussion of the papers provided an occasion for a lively duel concerning the relative merits of the selenium cell and the photo electric cell But a welcome innovation, that of demonstrations, during the tea interval, of the subjects of papers of experimental interest, gave an opportunity, of which most of the members of the audience made full use, for that informal interchange of ideas which is, perhaps, one of the most valuable features of a discussion This apart, the experimental illustrations, which included an exhibit of photo electric cells of the type developed by Prof Lindemann, and a demonstration by Prof Thirring, of Vienna, made all the difference, for one hearer at least, between vague and vivid memories of a very valuable discussion

ALLAN FERGUSON

New Recording Anemometers

WE have received a communication from Prof W W Shoulejkin, of the Institute of Physics and Biophysics of Moscow, giving particulars of apparatus which he has designed for automatic measurement of the two following quantities

(1) The amount of air that passes in a given interval of time across a unit of area normal to the instantaneous flow of the wind This is a modification of the ordinary Robinson anemometer, arranged so that a paper tape is unrolled by an amount dependent upon the flow required

(2) The instantaneous components of unit wind velocity in any two horizontal directions at right angles, or, in other words, the values of cos θ and sin θ, where θ is the angle between the direction of the wind and any fixed horizontal datum line, for example, the tangent to the coast line at a seaside place

No special difficulty appears to have been attached to the designing of suitable link mechanism for achieving these ends, and it is stated that the apparatus is not costly to produce A specimen has been supplied to the hydrophysical station of the above mentioned

FIG 1

institute at Kaziveli (Crimea) for use in solving problems connected with the transference of heat and water vapour from the Black Sea to the adjacent land

Another use suggested is for determination of the mean vector speed and direction of the wind at any place In this case the axis of reference will be the east west or south north line

The mechanism for achieving item (1) above is shown in Fig 1 *R* is a ratchet wheel, and *M* an electromagnet Every time that the cups of the anemometer complete one revolution, they complete an electrical circuit which brings this electromagnet into operation, and the latter turns the ratchet wheel

FIG 2

forwards by one tooth, this causes a definite length of the tape *T* to be unrolled *D* is a disc which bears twelve rubber zeros and twelve rubber dots on its face, equally spaced around the axis The disc *D* is turned by the hour hand of a clock, so that every half-hour a zero or dot comes opposite to the tape The minute hand *S* of the clock completes an electric circuit through screw *A* or screw *B* every time that this happens, and by this means another electromagnet is bought into action which draws forward the iron disc *H* and makes a zero or dot on the tape In this way the run of wind for each half hour can be measured on the tape

The mechanism for achieving item (2) is shown in Fig 2 *T* is the axis of a wind vane to which is rigidly attached an inclined disc *K* The changes in the direction of the wind therefore cause *K* to revolve in a skew manner

A roller attached to a sliding piece *P* conveys the simple harmonic movement in the vertical of the upper surface of the disc *K* near to *P* to a pen arm (*F*) linked with *P*, this movement being recorded on a chart attached to the drum *U*, which is turned by clockwork In a similar manner, a second pen conveys the vertical movements of the disc at a point 90° from *P* through the agency of the sliding piece *L* Now the difference in phase of 90° ensures that if the apparatus is so set that the displacements of *F* are proportional to the cosine between the direction indicated by the vane and the axis of reference (for example, the coast line), then the second pen will record the sine of that angle

Atlantic and Pacific Land-Bridges [1]

THE value of zoogeography as the pathfinder for geology is being more widely recognised Dr von Ihering summarises in this paper some of the conclusions from his life's study of the biological relations of South America to the history of the Atlantic and Pacific Oceans He agrees in general with the conclusions put forward in 1929 by Prof J W Gregory (see NATURE, April 20, 1929, p 622) in the presidential address to the Geological Society on the "History of the Atlantic" Dr von Ihering considers that the North and the South Atlantic were separated until the Miocene period by land that extended from West

Africa to the Antilles and South America South of that land there was some connexion between the seas of Egypt and South Africa The faunas of the North and the South Atlantic first intermingled in the Upper Miocene period

The argument for the separation of South America and Africa by drift based on the shape of South America is invalid, as that shape was developed only in the Middle Quaternary Previously the South Atlantic was a warm sea, and mangroves lived as far south as the Rio Negro earth movements then admitted a cold current, and the mangroves were driven 12° northwards, the change of climate exterminating the great Argentine Edentates

The Pacific Basin in Upper Cretaceous time was traversed by a land for which is suggested the name 'Archipacifis' Its eastern part extended along western North America as Schuchertland and along South America as Burckhardtland The three sections were each a centre of mammalian development The *Notostylops* fauna and the Dakota flora reached Patagonia by way of Archipacifis The first immigration was earlier than the advent of Creodonts

Archigalenis is a remnant of Archipacifis, and was the only Kainozoic trans Pacific land bridge it lasted until the end of the Miocene period To land west of America was due the range of the American Edentates, the intermingling in Patagonia of the northern and southern floras, and the occurrence in Mexico of an outlier of the southern crayfish and their parasites

The view that the bears reached South America by Miocene time cannot be maintained, as it is based on fossils from the Pampas Formation having been accepted as from the Entrerios Beds The isolation of Patagonia from Brazil until the Middle Miocene is now proved by deep bores under the pampas

A land connexion across the southern Pacific between Australia and Patagonia is shown by, among other evidence, that of *Prothylacinus*, which, with its eight incisors, is a carnivorous marsupial, and not a Creodont

[1] Substance of a paper by the late Dr H von Ihering on Land Bridges across the Atlantic and Pacific Oceans during the Kainozoic Era communicated by Prof J W Gregory to the Geological Society of London on June 11

Technical Teachers in Conference

THE twenty first annual conference of the Association of Teachers in Technical Institutions was held at Brighton during Whitsuntide when the retiring president, Mr A E Evans (Battersea Polytechnic) installed Mr H A Norman (Headmaster, Junior Technical School, Bury) as president for the coming year

Delivering his presidential address, Mr Norman commented upon changes in industry and education It is not yet fully realised, he said, that a provision of technical education which suits an industrial system of small manufacturers and operations carried out by large skilled labour forces does not meet the needs of a changing system in which industry is organised in larger units and in which a more highly trained skill is necessary in a smaller body of workers Among the steps which are being taken to meet the problems presented by this change he indicated the work of the Emmott, Malcolm, and Balfour committees which dealt with problems of education and industry, the series of inquiries, memoranda, and reports which are being steadily made by the Board of Education, and the government committees on salesmanship and engineering He specially stressed two reports on local areas, Yorkshire and the West Midlands metal working area

Surveying the activities of the A T T I, the president insisted that they are not concerned alone with problems of industry and technical education A well-balanced system of education needs co ordination of all its branches It is to be expected, therefore, that teachers' associations should form joint committees to examine mutual problems Such joint committees (for example, the Joint Six Committee of the N U T, four secondary associations, and the A T T I) are attempting to frame policies and to make decisions which affect the whole teaching world They are acquiring a status which suggests they will be able to take other steps which may be desirable Recently, it is true, when questions of detail were discussed, the need for independent action by some of the constituent associations had appeared—a fact which points to the conclusion that attempts to force unity will tend to perpetuate differences rather than to promote common action

Mr Norman made a special plea for junior technical schools in connexion with the raising of the school leaving age It is clear, he said, that the change will profoundly affect work which falls within the province of the A T T I Technical institutions will expect, as a result of the advance in staffing and equipment which the raising of the age should involve, that students will enter on technological studies much better prepared than is now the case From the experience of the junior technical school the question of staffing is of vast importance, since the success of any scheme depends ultimately on the teacher The raising of the leaving age will keep within the ranks of full time pupils those who are growing from childhood to adolescence, for all pupils a large proportion of this period of rapid growth and emotional change will, in future, be accomplished during school life What steps are being taken to meet the new facts and conditions? Endless heavy and monotonous toil such as is often suffered by children who enter industry at twelve and thirteen years of age is not part of the birthright of any child, but neither is an education which does not satisfy because it fails to use the ambition of boys and girls to be up and doing in the world There is a part in all of us which is practical rather than wholly bookish, there are children whose whole nature can best be developed by reference to those practical instincts The admitted success of the junior technical school has been due to the fact that, while it does not neglect the academic side, a good proportion of its time is spent in pursuits which involve practical work in rooms other than class rooms Its staff, too, includes teachers who are themselves directly acquainted with the conditions of life which face pupils not only in industry and commerce, but also in the greater part of the circumstances arising therefrom which go to make up the life of a young person

Mr Norman insisted that the A T T I could not wholly discharge its function through the media of its local and national activities The advance of science is slowly breaking down international barriers, certain international problems cannot, therefore, be avoided He was happy, however, to be able to report work done in connexion with the interchange of teachers through the English speaking Union, and the share which the association has taken in the work of a committee of local education authorities, teachers' associations, and the League of Nations Union, which,

with regard to the inclusion of League of Nations teaching in schools, has recently presented its report to the President of the Board of Education

Among the resolutions dealt with by the Conference was one which urged the necessity for connecting links between government departments concerned with education schemes (for example, Ministries of Health, Labour, Agriculture, and Education), and one which pleaded for legislation recognising for purposes of superannuation all full time service in university colleges, prior to the introduction of the present university superannuation scheme, as service in a technical institution

University and Educational Intelligence

LONDON —Applications are invited for the Laura de Saliceto studentship for the advancement of cancer research The studentship will be tenable for not less than two years, and the annual value £150 The latest date for the receipt of applications by the Academic Registrar, University of London, South Kensington, S W 7, is July 1

MANCHESTER —A limited number of research scholarships in technology will be awarded in July next by the Manchester Municipal College of Technology The value of each will not exceed £100 Research may be undertaken in any of the following departments mechanical engineering, electrical engineering, municipal engineering, applied chemistry, textile industries, photographic technology, printing, and industrial administration There are also scholarships of a yearly value of not more than £100 each, to part time students of the College and others who are Manchester ratepayers or sons or daughters of Manchester ratepayers Applications must reach the Registrar on June 27 at latest

OXFORD —In proposing the acceptance of the offer by Sir William Morris to place the Radcliffe Observatory site and buildings in the hands of trustees for the benefit of the Radcliffe Infirmary and the Medical School, Professor G Dreyer directed attention to the unique character of the gift, spoke of the closer connexion between the University and the Infirmary which it would favour, and pointed out that it would provide room for the extension of the Infirmary, and for the development of post graduate teaching

The report just published of the Delegates of the University Museum announces that a scheme has been put into operation whereby details of certain vacancies requiring candidates with scientific training can be brought to the notice of the teaching staffs of the Museum departments

The reports of the various scientific departments contain lists of research work published during the year, and accounts of accessions to the collections These are especially copious in the case of the Pitt Rivers Museum and the department of the Hope professor of zoology Noteworthy among the former are a collection from the Bororó tribe of Brazil, made by Mr George M Dyott during his expedition in search of traces of the late Col Fawcett, and a very remarkable series of wooden objects found in a cave in Tanganyika Territory, among the latter a fine series of Paraguayan butterflies presented by the late Dr Charles Hose, a great collection of ants made by Mr W Cecil Crawley, a large number of Coleoptera from Windsor Forest given by Mr Horace Donisthorpe, and a very full collection of British Lepidoptera by Dr Nevil Sidgwick This collection, part of which was made in the company of the late Mr Arthur Sidgwick, contains a specimen of the North American *Danaida plexippus* caught at Lyme Regis in 1886

A SCHOLARSHIP of the value of £100 for post graduate research on wool has been instituted by the Weavers' Company The research will be carried out in the laboratories of the Wool Industries Research Association Applications should be sent not later than June 30 to the Secretary, Wool Industries Research Association, Torridon, Headingley, Leeds

FROM the Imperial College of Tropical Agriculture, Trinidad, we have received a pamphlet containing a prospectus for 1930–31, the principal's report for 1928–29, and a register of staff and students Courses are offered in agriculture, botany, chemistry and soil science, economics, mycology and bacteriology, tropical sanitation and hygiene, technology (chemical machinery, sugar technology, colloid science, physical chemistry, field and factory control), veterinary science, zoology, and entomology A diploma course covering three years, a one year course, refresher courses, and various post graduate courses are provided Fifty five students were in residence last year, including twenty seven graduates The instructional staff numbered sixteen In addition to numerous shorter notes and articles in the college journal, *Tropical Agriculture* (6d monthly), twenty-one scientific papers were published during the year Research is, in the main, concentrated, so far as concerns long range investigations, on four crops, namely, sugar cane, bananas, cacao, and limes The plant includes a sugar cane factory in which more than a thousand tons of cane were dealt with during the year

Historic Natural Events

June 23, 1783 Severe Frost — Great damage was caused in Britain by a severe frost Trees and fruit crops suffered badly, and also barley, oats, and rye Ice a quarter of an inch thick was formed on tubs of water

June 23, 1783 Dust Haze —Gilbert White, in the "Natural History of Selborne", describes a peculiar haze or smoky fog which prevailed for many weeks in Britain and many parts of Europe on June 23–July 20, "during which period the wind varied to every quarter, without making any alteration in the air The sun, at noon, looked as blank as a clouded moon, and shed a rust coloured ferruginous light on the ground and floors of rooms, but was particularly lurid and blood coloured at rising and setting All the time, the heat was so intense that butchers' meat could hardly be eaten the day after it was killed, and flies swarmed so in the lanes and hedges that they rendered the horses half frantic and riding irksome" The haze was undoubtedly due to volcanic dust from the eruption of Asama

June 23, 1921 Thunderstorm and Flood —The city of T'ung Chuan, in the province of Sz Chuan, in the interior of China, was visited by a severe thunderstorm which began at 1 A M and continued for twelve hours During that time the rainfall amounted to 7 45 in The level ground surrounding the city was flooded knee deep and corn was beaten down everywhere The water entered the west gate, destroying many huts, and even some more solidly built houses fell down Several people were drowned and many others rendered homeless Two soldiers were struck by lightning and killed, others were rendered speechless The Chinese said that they had not experienced such a storm for many years, and that it occurred because a dragon had been stolen from one of the temples outside the west gate

June 24, 1034 Frost —The Anglo-Saxon Chronicle records that "On Midsummer Day there was such a vehement frost, that the corn and other fruits of the

earth were blasted and killed, so that thereupon followed a great dearth in all the country "

June 24, 1897 **Hailstorms** —The morning was very hot in England, and during the afternoon a series of violent thunderstorms developed at many widely separated localities The greatest damage was done by a storm which crossed Middlesex and continued to Colchester in Essex, accompanied by violent winds and heavy hail, the stones being described as ' as big as hens' eggs " The storm played havoc with the Diamond Jubilee decorations, broke thousands of panes of glass, smashed tiles, blew down chimneys and trees, ruined crops, and killed thousands of birds There was great distress among the farmers in Essex, for there had not been a bad hailstorm for some years, and many of them had given up insuring against hail, the Lord Mayor of London opened a relief fund for the benefit of the sufferers

June 25, 1545 **Thunderstorm** —A great tempest occurred in Derbyshire, in which trees were overturned and churches, chapels, and houses unroofed In Lancashire hailstones fell, said to be as big as a man's foot

June 28, 1788 **" The Midsummer Flood "**—Whistlecraft, in " Rural Gleanings ", states that the most remarkable rain ever known in northern Suffolk in June, " came down in awful torrents for some hours, until it caused the greatest inundation ever recorded in these parts It has ever afterwards been called ' The Midsummer Flood ' "

June 28–July 4, 1901 **Heat Wave** —A spell of uniformly high temperature produced more serious effects in New York than had ever been experienced before Even at night the thermometer rarely fell below 80° F, and the air was very humid The asphalt with which the streets were paved softened with the heat, and the wheels of vehicles ploughed deep ruts in the roadways Outdoor work was practically suspended, and even the Stock Exchanges in New York and Boston were closed 150,000 people abandoned New York city, and thousands more slept in the public parks, which were kept open at night for that purpose The hospitals were overcrowded with cases of heat prostration, while several hundred people and more than a thousand horses died from heat stroke

June 28, 1917 **Heavy Rain** —A depression passed along the English Channel, and very heavy rain fell over Somerset At Sexey's School, Bruton, the amount measured was 9 56 in, a large part of which fell between 11 P M on June 28 and 1 A M on June 29 This is the heaviest fall in twenty four hours on record in the British Isles At King's School, Bruton, the amount was 8 48 in It is estimated that during this storm 525,000 million gallons, or 2340 million tons of water fell in England and Wales A great volume of water flowed along the valley of the Brue towards Burnham At Bruton the valley narrows, and the town bridge confines the river still further, and here the water, unable to pass, flooded the low lying parts of the town, doing much damage

June 28, 1928 **Heavy Rain** —Continuous heavy rain fell over the mountains of North Wales during strong south westerly winds, the total reaching 7 77 in at Blaenau Festiniog in Merioneth The rainfall was largely due to the mountains, but an analysis of the weather charts showed that the winds were derived from two separate sources, a relatively cool current from the northern North Atlantic and a warmer current from farther south These two currents were brought side by side, and it is probable that the cool current spread sideways under the warmer and moister air, raising it steadily and continuously throughout the day, and so greatly increasing the rainfall

Societies and Academies

LONDON

Linnean Society, May 15 —H R Hewer Studies in colour changes in fish (Pt 5) The colour patterns in certain flat fish, and their relation to the environment Microscopical examination of the chromatophores, which form the basis of the colour patterns, shows that the spots occurring on the upper side of the body may be divided up into groups according to their characters, such as distribution, size, and constituent chromatophores These groups constitute the ' patterns ', and they act as distinct entities, all the spots belonging to any particular pattern reacting in the same manner to any one stimulus The constitution of any given type of spot is remarkably constant with a species Among the fish examined, those having the greatest number and complexity of colour patterns and therefore possessing the machinery for the largest range of adaptation, are the turbot (*Rhombus maximus*) and the brill (*R lævis*) which are noted for their habit of moving over considerable areas A study of the constitution of the spots in young forms in closely related species has demonstrated a series of stages of complexity approximating to the lines along which evolution has probably taken place —E M Delf The release of oogonia in the Fucaceæ The first species considered was of *Bifurcaria brassiciforme*, one of the Fucaceæ common on the shores of the Cape Peninsula Comparison was then made with other genera of intertidal habitats such as *Fucus*, which is habitually exposed during the fall of the tide and *Sargassum* and *Cystophyllum*, which are intertidal but constantly covered even at low spring tides in most localities

Geological Society, May 28 —H H Swinnerton The post Glacial deposits of the Lincolnshire coast The clays which underlie the Lincolnshire marsh land crop out between the tide lines along the coast, and many temporary exposures have been examined in the vicinity of Chapel St Leonards and Ingoldmells These deposits lie upon an uneven floor of boulder clay, and may be divided into Lower, Middle, and Upper Series, separated by well defined erosion surfaces The lower series consists of peat enclosing remains of oak, alder, and birch It was formed during Neolithic times, when the area must have been at least 20 feet above its present level The middle series consists almost entirely of purple and grey buttery clays, and rests upon an eroded surface of boulder clay and peat It is usually 7 feet thick, and is divisible into lower and upper portions by a marked difference in the contained flora The upper series consists of grey, purple, and black sloppy clays, with numerous *Scrobicularia* and *Cardium* in their lowest portions The thickness varies from 18 to 9 feet There is evidence that this series was formed after the Roman occupation The character and contents of these post Glacial deposits indicate deposition under estuarine conditions, associated with the presence of an off shore barrier, probably breached during the thirteenth and fourteenth centuries, thus establishing the present exposed condition of the coast

Mineralogical Society, June 3 —L J Spencer A new meteoric iron from Piedade do Bagre, Minas Geraes, Brazil This mass, found in 1922 and weighing 130 lb, is of special interest in showing on one corner a well marked octahedral fracture, and on a polished and etched section taken from this portion of the mass a complex system of very distinct Neumann lines Neumann lines are twin-lamellæ

produced by gliding on planes of the icositetrahedron (211), and it is believed that these, as well as the octahedral fracture, were developed by the shock of impact when the meteorite fell with its corner on hard rock —**Miss Jessie M Sweet** Notes on British barytes It is shown that the localities of barytes and fluorite follow the outcrop of the Whin Sill in the north of England and of the toadstones in Derbyshire Attention is directed to a change in colour from yellow to blue in some barytes crystals from Mowbray mine, Frizington, Cumberland, on exposure to the light Zoned crystals and some rare crystal forms are described —**M H Hey** On face and zone symbols referred to hexagonal axes The three hexagonal zone symbols for any one zone referred to the Bravais axial system and obtained by cross multiplication of face symbols dropping the first, second, or third index, all obey the Weiss zone law and, when added together, applying a factor of 2/3 for the fourth index, yield a four index zone symbol identical with that obtained for the zone from the gnomonic or linear projection This four index zone symbol also obeys the Weiss zone law if a factor of 3/2 be applied to the unique index when operating upon the face symbols of a face in the zone General expressions are obtained for passing from any one of the three index zone symbols to the other two and also to the four index symbol and vice versa —**L J Spencer** Biographical notices of mineralogists recently deceased (fourth series) For the past three years thirty eight biographies are included Ages range from thirty two to ninety one years, with an average of sixty eight years Prominent are P Groth and G Tschermak, who both died in 1927 —**F Walker** A tholeitic phase of the quartz dolerite magma of central Scotland The tholeites of Dalmeny and Kinkell are described and shown to contain chlorophæite It is demonstrated by means of analyses and refractive index determinations that the residual glass is of acid composition in both rocks a conclusion which does not support some of the ideas of Dr C N Fenner on the crystallisation of basalt —**M H Hey** On pink epsomites and fauserite A supposed specimen of the latter in the British Museum proves to be pink epsomite Fauserite is a doubtful species

Physical Society, June 13 —**E J Williams** (1) The induction of electromotive forces in a moving liquid by a magnetic field, and their application to the investigation of the flow of liquids A magnetic field induces electromotive forces in a moving liquid and by investigation of the e m f 's produced by a known magnetic field it is possible to obtain information about the distribution of velocities in the liquid Potential differences of the order of 10^{-4}-10^{-3} volts, set up by a magnetic field in an aqueous solution of copper sulphate, can be satisfactorily measured (2) The motion of a liquid in an enclosed space The increase of resistance of a column of mercury in a magnetic field, found in experiments on this effect, is due to the internal motion of the liquid produced by the action of the ampère forces between the magnetic field and the electric current traversing the mercury E m f 's so small as 10^{-6} to 10^{-7} volts, induced by a magnetic field in moving mercury, can be accurately measured —**E V Appleton** Some notes on wireless methods of investigating the electrical structure of the upper atmosphere (2) The relations between the optical and equivalent paths of waves deviated by the upper atmosphere and between the rates at which these quantities may vary with time are investigated theoretically, and, from the results of experiments carried out to test these relations, deductions are made concerning (*a*) the existence of more than one ionised region in the upper atmosphere, (*b*) the possible influence of magnetic storms on atmospheric ionisation, (*c*) the gradient of ionisation in the upper atmosphere and its alteration under solar influence at sunrise, and (*d*) the actual height reached by waves deviated in the upper atmosphere —**C R Darling** A simple method of showing the modes of vibration of a wire The wire is heated with alternating electric current and its tension varied, the various modes are easily observable owing to the luminosity of the wire

DUBLIN

Royal Irish Academy, May 26 —**R W Ditchburn** Notes on resolving power The nature of the Rayleigh conception of resolving power and its range of application are discussed We may usefully distinguish three stages in resolution, first, when inhomogeneity may be detected, second when the number and wave length separation of the components can be distinguished, and third, complete resolution when both wave lengths and intensities can be accurately measured The Rayleigh criterion corresponds roughly with the second stage The paper includes sections dealing with (*a*) the difference between visual and photographic photometric resolution, (*b*) the difference between resolution of emission and absorption lines, (*c*) the resolution of lines of unequal intensity, (*d*) the resolution of lines of finite breadth The fundamental conditions affecting the practical efficiency of methods for wave length resolution are considered

EDINBURGH

Royal Society, May 26 —**Niels Bohr** Philosophical aspects of atomic theory Recent experimental and theoretical studies of physical phenomena have revealed a limitation in our ordinary concepts of natural philosophy as regards the description of the behaviour of single atoms This limitation is an immediate consequence of the discovery of the elementary quantum of action, which excludes a simple distinction between the atomic phenomena and the observation, since any observation necessarily involves a finite change in the course of the phenomena This circumstance prevents a pictorial description of atomic phenomena and allows us to apply physical concepts only in connexion with probability considerations The new situation in physics with which we are thus confronted presents a remarkable analogy with situations with which we are familiar from studies in biology and psychology

PARIS

Academy of Sciences, May 5 —**E Goursat** The singular multiplicities of systems in involution —**Georges Perrier** The Rohan Chabot expedition (Angola, Zambezi) This was an expedition organised privately by Comte Jacques de Rohan Chabot A résumé is given of the geographical, magnetic, and meteorological observations —**Ch Achard** and **M Enachesco** The variations, spontaneous or provoked, of the distribution of chlorine between the serum and the blood corpuscles in disease The results obtained broadly confirm those previously described concerning the variations of the chlorine and of the acid base equilibrium in morbid states, particularly in cyclic diseases —**Paul Delens** The analytical representations of cycles of space —**F Campus** Correction of the mean fibre of the arches of barrages —**B Galerkin** Contribution to the general solution of the problem of the theory of elasticity in the case of three dimensions —**Benjamin Jekhowsky** The calculation of the dimensions of the orbit of the new trans Neptunian celestial body —**M** and **Mme Henri Mineur** The

rotation of the local star cluster and the galaxy —**Jean Peltier** The search for defects in ferromagnetic test pieces By the use of a four valve amplifier and a loud speaker, superficial faults of one cubic millimetre produce sounds audible all over the laboratory at present the method is limited by the fact that the penetration is only some millimetres into the test specimen, but this defect may be overcome by the use of more powerful magnetic fields —**E Rinck** The equilibrium, in the fused state, between sodium, potassium, and their fluorides The law of mass action (Na)(KF)/(K)(NaF)=c has been verified, c being a constant of about 0 29 —**Mlle Amagat** The action of sodium amide on some alkyl bromides Bromides of the type $(C_6H_5)R$ CH CH_2Br treated with sodium amide in xylene solution give almost exclusively the symmetrical hydrocarbons C_6H_5 CH – CH R —**Ch Courtot and J Pierron** Contribution to the study of alcohols unsaturated in the β *or* γ positions —**Henri Besairie** The stratigraphy of the secondary and tertiary formations of the province of Betioky (south west Madagascar) —**Jacques de Lapparent** The mineralogical and chemical behaviour of the alteration products of the gneiss of the French central massif, before the establishment of the sedimentary deposits of the Oligocene - **C and M Schlumberger** The electromagnetic determination of the direction of sedimentary deposits —**Mlle Lucienne George** *Ephedra nebrodensis* of the north of Africa An account of the modifications of the plant due to the change in medium, more especially the intense insolation —**A Guillaume** The migration of the alkaloids in the course of the germination of seeds and the formation of the embryos researches on *Lupinus mutabilis*, var *Cruiskanks* —**Antonin Nemec** A rapid method for the determination of the effect of phosphatic manures on the yield of cultures The method is based on the fact that the proportion of ferric oxide in a soil affects the action of a phosphatic manure —**Gordon H Scott** The localisation of the mineral constituents in the cellular nuclei of acini and the excretory ducts of the salivary glands —**A Policard and Mlle V Mouriquand** The tissue reactions provoked by the intraconjunctival injection of particles of asbestos An experimental study of pulmonary asbestosis —**J Abelous and R Argaud** The secretory activity of the nuclei in the suprarenal adenomes —**Mlle Andrée Courtois** The proportions and variations of the phosphorus in the course of nymphosis of some Lepidoptera —**Edouard Chatton, André Lwoff, and Mme Marguerite Lwoff** The Phoretophrya ciliated Fœttingeriideæ, hyperparasites of the Gymnodinioides, parasite Fœttingeriideæ of the Crustacea

PRAGUE

Czech (Bohemian) Academy of Sciences and Arts (Second class, Natural Science and Medicine), April 4 —**L Seifert** A geometrical theory of the general surface of the third order —**E Votoček, F Valentin, F Rac** Studies in the rhamnose series The molecule of water in rhamnose, $C_6H_{12}O_5$ H_2O_1, is not constitutive but crystalline, since the combination of *d*- and *l* rhamnose in aqueous alcohol yields anhydrous racemic rhamnose, $(C_6H_{12}O_5)_2$ —**J Klima** The determination of the order and de composition of lines of striction of algebraic ruled surfaces —**J Kokta** Some physico chemical properties of opals and their relation to artificial amorphous silicic acids —**B Gosman** Reduction of sulphurous acid at the dropping mercury cathode , Sulphurous acid is reversibly reduced at about - 0 2 v to hydro sulphurous acid, only undissociated molecules being capable of reduction Normal sulphites are not reducible —**J H Krepelka** The atomic weight of arsenic (I The analysis of arsenic trichloride) The mean value derived from thirteen determinations of the ratios $AsCl_3$ 3Ag and $AsCl_3$ 3AgCl is As = 74 936 ± 0 001, if silver is taken as 107 88 and chlorine as 35 458 This figure agrees closely with that of Aston (74 934) derived from the mass spectrum —**O Quadrat, T Korecky** Complex organic compounds with aluminium hydroxide

Official Publications Received

BRITISH

Department of Scientific and Industrial Research Building Research Abstracts Vol 3 (New Series), No 4 April Abstracts Nos 071 001 Pp 118 153 (London H M Stationery Office) 9*d* net

Commonwealth of Australia Council for Scientific and Industrial Research Catalogue of the Scientific and Technical Periodicals in the Libraries of Australia. Edited by Ernest R Pitt Pp xxiv + 1208 (Melbourne H J Green) 10*s*

A Short Account of the Work of the Indian Lac Research Institute Pp 23 (Namkum Ranchi)

Journal of the Indian Institute of Science Vol 13A, Part 5 Soil Survey of the Nalkantha District (Limbdi State) and its Significance By C V Ramaswami Ayyar Pp 43 55 (Bangalore) 1 8 rupees

Department of Agriculture Straits Settlements and Federated Malay States General Series, No 2 The Brazil Nut in Malaya By J Lambourne Pp 15 + 5 plates (Kuala Lumpur) 50 cents

Journal and Proceedings of the Asiatic Society of Bengal New Series, Vol 25 1929 No 1 Pp 318 + 9 plates (Calcutta) 10 units

Armstrong College Newcastle upon Tyne Standing Committee for Research Report Session 1928 1929 Pp 31 (Newcastle upon Tyne)

Somaliland Agricultural and Geological Department Annual Geological Report for 1929 Pp 12 (London The Crown Agents for the Colonies) 2*s*

Journal of the Royal Statistical Society Vol 93, Part 2 Pp 183 341 + xii (London) 7*s* 6*d*

Patents Designs and Trade Marks. Forty seventh Report of the Comptroller General of Patents, Designs and Trade Marks with Appendices for the Year 1929 Pp 24 (London H M Stationery Office) 4*d* net

Transactions and Proceedings of the New Zealand Institute Vol 60, Part 4 December 1929 Pp iv + 521 661 (Wellington N Z)

Transactions of the Institute of Marine Engineers Incorporated Session 1930 Vol 42 May Pp 205 293 + xl (London)

Institution of Chemical Engineers Papers presented by Members at the World Engineering Congress Tokio October November 1929 (Papers 277 284) Pp 100 + 12 plates (London) 10*s* 6*d*

Annual Report of the Zoological Society of Scotland for the Year ending 31st March 1930 Pp 68 + 16 plates (Edinburgh)

Empire Cotton Growing Corporation Report of the Administrative Council of the Corporation submitted to the Ninth Annual General Meeting on May 29th, 1930 Pp ii + 80 (London)

Ordnance Survey Results of the Magnetic Observations made by the Ordnance Survey in England and Wales in 1928, and Preliminary Results (Declination only) of those made in Scotland in 1929 Pp 7 (London H M Stationery Office) 1*s* net

Empire Marketing Board May 1929 to May 1930 (E M B 28) Pp 99 (London H M Stationery Office) 1*s* net

Department of the Interior North West Territories and Yukon Branch The North West Territories, 1930 By F H Kitts Pp 137 (Ottawa F A Acland)

Journal of the Chemical Society May Pp vi + 905 1276 + xii (London)

The National Benzole Association Seventh Report of the Joint Benzole Research Committee of the National Benzole Association and the University of Leeds (Presented May 21st 1930) Pp ii + 149 + 6 plates (London)

Australia Third British Empire Forestry Conference Australia and New Zealand, 1928 Proceedings Pp 309 + viii (Canberra H J Green)

FOREIGN

University of Illinois Engineering Experiment Station Bulletin No 202 Laboratory Tests of Reinforced Concrete Arch Ribs By Prof Wilbur M Wilson Pp 90 55 cents Circular No 20 An Electrical Method for the Determination of the Dew Point of Flue Gases By Henry Fraser Johnstone Pp 22 15 cents (Urbana Ill)

United States Department of Agriculture Circular No 116 Calcium Arsenate Dusting as a Cause of Aphid Infestation By J W Folsom and F F Bondy Pp. 12 (Washington D C Government Printing Office) 5 cents

Svenska Linné Sällskapets Årsskrift Årgång 13 1930 Pp viii + 190 (Uppsala Almqvist and Wiksells Boktryckeri A B)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 82 Studies in African Acrydiinae (Orthoptera Acrididae) Part 1 Cladonotae, Scelimenae and Metrodorae By James A G Rehn Pp 91 187 + 4 plates (Philadelphia)

Journal of the Faculty of Agriculture, Hokkaido Imperial University Sapporo, Japan Vol 28 Part 6 Synthese gerbender Stoffe Teil 2 Von Prof Dr G Grasser und K Hirose Pp 189 228 (Tokyo Maruzen Co , Ltd.)

U S Department of Commerce Bureau of Standards Miscellaneous Publication No 108 Manufacture and Properties of a Cellulose Product (Maizolith) from Cornstalks and Corncobs By C E Hartford Pp 10 (Washington, D C Government Printing Office) 5 cents

The Science Reports of the Tohoku Imperial University Sendai Japan. Fourth Series (Biology) Vol 5 No 1 Pp 218 + 8 plates (Tokyo and Sendai Maruzen Co., Ltd)

Kungl Sjökarteverket, Stockholm Ergebnisse der Beobachtungen des Magnetischen Observatoriums zu Lovö (Stockholm) im Jahre 1928 Pp 33 Jordmagnetiska Publikationer Nr 7 Jordmagnetisk Översiktskarta över Sverige 1930 (Magnetic General Chart of Sweden 1930) Av Gustav S Ljungdahl Pp 4 (Stockholm)

Bulletins of the Pacific Scientific Fishery Research Station Vol 3, Part 1 МАТЕРИАЛЫ ПО РЫБАМ ШАНТАРСКОГО МОРЯ (Material about the Fishes of the Shantar Sea). By G U Lindberg and G D Dulkeit. (With Summary in English) Pp. 139 2r 50k Vol. 3, Part 2 К ПОЗНАНИЮ ДОННЫХ СООБЩЕСТВ ШАНТАРСКОГО МОРЯ (Upon the Bottom Communities of the Shantar Sea—S W Okhotsk Sea). By I Zachs (With Summary in English) Pp 112 1r 90k (Vladivostok)

Journal of the Faculty of Science, Imperial University of Tokyo Section 1 Mathematics, Astronomy, Physics, Chemistry Vol 2, Part 2 Über die Automorphismen einer endlichen zerlegbaren Gruppe Von Kenjiro Shoda. Pp. 25 50 0 60 yen Section 3 Botany Vol. 2 Part 3 Studies on the Structure of Japanese Species of Ranunculus By Masao Kumazawa Pp 297 348 1 00 yen (Tokyo Maruzen Co , Ltd)

Smithsonian Institution Explorations and Field Work of the Smithsonian Institution in 1929 (Publication 3060) Pp iv+222 (Washington D C Smithsonian Institution)

Smithsonian Institution United States National Museum Bulletin 100 Contributions to the Biology of the Philippine Archipelago and adjacent Regions The Fishes of the Families Amiidae, Chandidae, Duleidae and Serranidae, obtained by the United States Bureau of Fisheries Steamer *Albatross* in 1907 to 1910, chiefly in the Philippine Islands and adjacent Seas By Henry W Fowler and Barton A. Bean Pp ix+334 (Washington, D C Government Printing Office) 60 cents

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Annual Report of the Meteorological Observatory of the Government General of Tyôsen for the Year 1927 Pp iv+154 (Zinsen)

National Research Council of Japan Report No 1 March 1922 Pp iii+20 Report No 2 3, April 1922–March 1924 Pp. iii+21 64 (Tokyo)

CATALOGUES.

Liver Extract B D H in the treatment of Pernicious Anæmia. Pp 7 (London The British Drug Houses Ltd)

Books and Prints arranged under the following headings Private Presses and Special Editions First Editions, Literature in General with a selection of books about Books, Old Prints and Maps (No 450) Pp 32 (Cambridge Bowes and Bowes)

Diary of Societies

FRIDAY, JUNE 20

ROYAL SOCIETY OF MEDICINE (Laryngology Section) (Summer Meeting) at 10 A.M – Papers by Dr D Crow, Dr A. Brown Kelly, Dr D McKenzie, T Neville E Watson Williams and others

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section) at 8 —A J Wrigley Puerperal Infection by the Pathogenic Anaerobic Bacteria —Dr H K. Griffiths (*a*) A Lithopædion (*b*) A Short Account of a Pregnancy in One Horn of a Bicornate Uterus

ASSOCIATION OF ECONOMIC BIOLOGISTS.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South Midland District Meeting) (at Harpenden).

SATURDAY, JUNE 21

NORTH OF ENGLAND INSTITUTE OF MINING AND METALLURGY (Newcastle upon Tyne) at 2 30 —Prof H Louis The Pitman s Yearly Bond —J T Whetton The Surveying of Bore-holes —Discussion on Paper by G E Tansley on The Value of the Economiser in Present Day Boiler Installations.

MINING INSTITUTE OF SCOTLAND (in Mining Laboratories, Grassmarket Edinburgh), at 3 —J S. Carson The Use of Iron and Steel for Underground Support —C McLuckie The Detection of Inflammable Gases and Vapours —Discussion on Paper by W J Skilling on Low Temperature Carbonisation

PHYSIOLOGICAL SOCIETY (at University College).—Prof. L Lapicque and others Discussion on The Time Relations of Excitation and their Significance in Central Nervous Phenomena

ROYAL SOCIETY OF MEDICINE (Disease in Children Section) (at Norwich).

MONDAY, JUNE 23.

ROYAL GEOGRAPHICAL SOCIETY (Annual General Meeting) (at Æolian Hall) at 3 —Presentation of Gold Medals and Awards President s Address Annual Report of the Council Election of President, Officers, and Council

ROYAL IRISH ACADEMY (Dublin).

TUESDAY, JUNE 24

QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W 1), at 7 30 —Gossip Meeting

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8 30

LONDON CLINICAL SOCIETY (at London Temperance Hospital).—Sir Robert Armstrong-Jones The Evolution of the Human Mind (Macalister Lecture).

WEDNESDAY, JUNE 25

GEOLOGICAL SOCIETY OF LONDON, at 5 30.—J E Richey The Geology of the Tertiary Igneous Complex of Ardnamurchan.

ROYAL SOCIETY OF ARTS —Annual General Meeting.

THURSDAY, JUNE 26.

ROYAL SOCIETY, at 4 30 —Prof A V Hill and P S Kupalov The Vapour Pressure of Muscle —Prof A V Hill The State of Water in Muscle and Blood and the Osmotic Behaviour of Muscle —W Sucksmith The Gyromagnetic Effect for Paramagnetic Substances —And other Papers

PHYSICAL SOCIETY (at Imperial College of Science), at 5 —M C Johnson The Effect of Photo-sensitised Mercury Vapour on the Walls of Silica Vacuum Tubes.—H R Nettleton and F H Llewellyn A Sensitive Rotating Coil Magnetometer —L Hartshorn The Frequency errors of Rectifier Instruments of the Copper oxide Type for A C Measurements —D S. Perfect A Method of Eliminating the Effects of Magnetic Disturbances in Highly Sensitive Galvanometers —*Papers to be read in title only* —M C Marsh The Thermal Insulating Properties of Fabrics —W Band The Classical Quantum Theory and X ray Excitation by Canal Rays and Alpha Particles.—A. T McKay Diffusion from an Infinite Plane Sheet Subject to a Surface Condition, with a Method of Application to Experimental Data —S Tolansky . Intensity Modifications in the Spectrum of Mercury

MEDICO-LEGAL SOCIETY (Annual General Meeting) (at 11 Chandos Street, W 1), at 8 —Prof J S Haldane Carbon Monoxide Poisoning

INSTITUTION OF MINING AND METALLURGY (at Geological Society).—Annual General Meeting

FRIDAY, JUNE 27

ROYAL SOCIETY OF MEDICINE (Otology Section) (at Nottingham) —Papers by Dr M Evans, Prof G Guida, Dr Densham, and L Yates

SATURDAY, JUNE 28

ROYAL SOCIETY OF MEDICINE (Orthopædics Section) (at St Vincent s Orthopædic Hospital, Eastcote near Pinner), at 3

ROYAL SOCIETY OF MEDICINE (Otology Section) (at Nottingham)

CONGRESSES.

JUNE 21 TO 28.

ROYAL SANITARY INSTITUTE (at Margate)

Monday, June 23 at 3 —Lord Cornwallis Inaugural Address

Tuesday June 24, at 10 A M —Meetings of Sections and Conferences.

A —Preventive Medicine
I —Representatives of Sanitary Authorities
V —Engineers and Surveyors
VI —Sanitary Inspectors
VII —Health Visitors (including Personal and Domestic Hygiene)

At 8 P M.—Dr O C Bradley Diseases of Domestic Animals from the Human Angle (Lecture).

Wednesday, June 25, at 10 A.M —Meetings of Sections and Conferences

A —Preventive Medicine
B —Engineering and Architecture
D —Hygiene of Food
VI —Sanitary Inspectors
VII —Health Visitors (including Personal and Domestic Hygiene)

Thursday June 26, at 10 A M —Meetings of Sections and Conferences

B —Engineering and Architecture
C —Maternity and Child Welfare (including School Hygiene).
F —Veterinary Hygiene
IV —Medical Officers of Health

Friday, June 27, at 10 A M —Meetings of Sections and Conferences

C —Maternity and Child Welfare (including School Hygiene)
E —Hygiene in Industry
F —Veterinary Hygiene
II —Representatives of Port Sanitary Authorities
III —National Health Insurance Services

JUNE 22 TO 28

INTERNATIONAL CONGRESS OF MINING, METALLURGY, AND APPLIED GEOLOGY (at Liége) —In three sections (*A*) Mining including Reconnaissance and Preliminary Work, Modern Methods of Working Coal Mines, Metalliferous Deposits and Quarries, Generation and Utilisation of Energy, Extraction Ventilation (Gas and Dust), and Mechanical Treatment of Ores and Coal (*B*) Metallurgy, dealing with Blast-furnace Practice, Steel and Ferrous Alloys Foundry Work, Non-ferrous Alloys and Fuels (*C*) Applied Geology, covering Metals, Fuels, Hydrology, and Geophysical Prospecting

JUNE 23 TO 27

MUSEUMS ASSOCIATION (at Cardiff).

Tuesday, June 24 (at Park Hotel), at 10 A M —Sir Henry A. Miers Presidential Address.

At 11 30 A.M —Dr O Lehmann Address
At 3 30 —Dr C Fox The National Museum of Wales

Wednesday June 25 (at Engineers Institute), at 9 30 A.M —Dr C Fox The Affiliation of Museums—the Opportunities and Difficulties of the Parent Museum

At 10 30 A.M —W C Sprunt and Dr T W Woodhead Papers on Rural Science
At 2 30 —Dr F J North Geology in Relation to the Small Museum.
At 3 15 —H A Hyde Botany in Relation to the Small Museum

SUMMER MEETING.

JUNE 21 TO 28

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in Holland)

SATURDAY, JUNE 28, 1930

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No 3165, Vol 125]

Biology for Young Children

IT is sound educational practice for teachers to avail themselves of the innate interests and inclinations of their pupils, especially in the earliest stages of their training The millennium is not yet, but a little child may lead us towards its advent in the teaching of biology In a paper entitled "The Biological Interests of Young Children", recently published in *The Forum of Education* (vol 7, No 3, and vol 8, No 1), Mrs Isaacs deplores the failure to link up the keenness evinced by little children in animal pets and in growing plants with later biological interests, and gives an illuminating record of her experiences at the Malting House School, Cambridge, with a group of children all of whom were less than seven years of age

Mrs Isaacs maintains that an active, continuous, and cumulative interest in animal and plant life, but particularly in animal life, develops easily and uninterruptedly out of the young child's innate curiosity and pleasure in these things, provided (1) that their adult associates emancipate themselves from prejudice and inadequate thinking as to the order in which plant and animal life should be dealt with, and the range of facts acceptable to children of tender age, and valuable educationally, and (2) that the child's actual direction of interest be followed, and heuristic help given Her records suggest strongly that children at this age are more actively and spontaneously interested in animals than in plants, that the animal interest is far more genuinely biological, plants being to the children little more than suitable gifts and decorations, that the facts of the life cycle in animals are more easily and directly observed and understood by the child, and thus that the animal interest is more easily sustained and naturally linked on to formal biological study

To generalise from comparatively few examples is, perhaps, rash, but Mrs Isaacs' experience will be confirmed by many who have to do with young children, and her conclusions merit careful consideration by those responsible for the education both of little and of older children

Another consideration that emerges from Mrs Isaacs' paper may be termed a moral one There is in most children a curious mixture of tenderness and cruelty towards animals, nor do the behaviour of carnivorous animals, and the apparent inconsistencies of the adult population with regard to animal food, animal clothing, sport and the like, help to make clear to the child that cruelty is wrong,

and that respect is due to all forms of life It was found, however, at the Malting House School that 'looking inside' some dead animals, and hearing something of the functions of the organs exposed by dissection, so far from increasing the impulses to cruelty in children, had the reverse effect The impulse to master and destroy was taken up into the aim of understanding a living mechanism not greatly differing from that of a human being

By encouraging in the children any interest shown in the processes of life, a steadily humane outlook was achieved, and a sense of responsibility towards pets and towards animals in general awakened and enlivened The standard of positive morality engendered by this method is of far more worth than the mere negative of not being unkind, and it expresses itself in eager interest in life histories, and sympathy with all animal activities

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Egyptian Mathematics

The Rhind Mathematical Papyrus British Museum 10057 and 10058 Photographic Facsimile, Hieroglyphic Transcription, Transliteration, Literal Translation, Free Translation, Mathematical Commentary, and Bibliography In 2 volumes Vol 1 *Free Translation and Commentary*, by Arnold Buffum Chace, with the assistance of Prof Henry Parker Manning, *Bibliography of Egyptian Mathematics*, by Prof Raymond Clare Archibald Pp vii + 210 Vol 2 *Photographs, Transcription, Transliteration, Literal Translation*, by Arnold Buffum Chace, Ludlow Bull, and Prof Henry Parker Manning, *Bibliography of Egyptian and Babylonian Mathematics (Supplement)*, by Prof Raymond Clare Archibald, *The Mathematical Leather Roll in the British Museum*, by Stephen Randolph Kingdon Glanville Pp xvi + 31 photographs + 109 plates + 12 + 8 (Oberlin, Ohio American Mathematical Association, 1927–1929)

When Prof T Eric Peet's handsome and in every respect admirable edition of the Rhind Papyrus appeared in 1923, anyone who read it must have felt that we had at long last (nearly fifty years had passed since the publication of Eisenlohr's edition) a definitive translation and commentary, with all such detailed discussion of points arising on the text and its interpretation as would give Egyptologists and mathematicians, once for all, a sound basis for further researches on the subject The immediate effect of Prof Peet's publication was to usher in an epoch of fresh intensive study of the principles of Egyptian mathematics, which bids fair to put into the shade the work of those pioneers, like Moritz Cantor and Hultsch, who first took the matter up after Eisenlohr First Mr Battiscombe Gunn published in the *Journal of Egyptian Archæology* for 1926 an invaluable critical notice of Peet's work covering fifteen pages of small print, in which he put forward many suggestions for improvements in the translation of the text and the mathematical interpretation, so important were these that, wherever Peet's work is quoted by later writers, we almost invariably find Mr Gunn also cited, the two are associated in a joint article in the *Journal of Egyptian Archæology* of November 1929 on four problems from the Moscow Papyrus, the publication of which in full is expected at an early date But there has been equal activity abroad Important papers have appeared in the last few years, notably those of O Neugebauer (1926), O Gillain (1927), and, last of all, Kurt Vogel in "Die Grundlagen der agyptischen Arithmetik" (1929), a book of 208 pages, which deals mainly with the table at the beginning of the Rhind, showing the decomposition, into a sum of submultiples, that is, fractions with numerator unity, of the results of dividing 2 by each of the odd numbers 3, 5, 7 up to 101, and which seems to be the most comprehensive work of all, since, in addition to the author's own elaboration of his subject, it contains notices of all earlier important contributions to the same

As regards the text and translation of the Rhind Papyrus, one would, on general principles, have expected Peet's edition to remain without a rival for, say, another fifty years Yet, within seven years of its publication, we have before us another which surpasses it in scale and magnificence Peet's edition contained, besides the valuable and comprehensive introduction extending to 32 of the folio pages, and the translation and commentary combined (covering nearly 100 pages), a hieroglyphic transcription of the text on 23 plates, with another reproducing the hieratic text of the New York fragments In the present edition, Vol 1 contains (1) a full introduction on Egyptian arithmetic and geometry generally, on Egyptian measures, and on the methods and aims of the Egyptian mathematician, with notes on the Egyptian calendar and chronology, then (2) a free translation and commentary suitable for the mathematician and the general reader, and (3) the first part (covering the period from 1706 to 1927)

of an extraordinarily valuable bibliography prepared by Prof R C Archibald, of Brown University The bibliography is not confined to works wholly devoted to the Papyrus, but includes numerous references to other mathematical, scientific, and Egyptological works, as well as popular papers and books, besides some of the literature of ancient Babylonian mathematics The bibliography is enriched, in the case of the most important works mentioned, by very useful accounts of the contents of those works, their relation to one another, etc , it covers altogether (with indices) 80 of the large pages , and it is continued in Vol 2 by a supplement of 13 still larger pages dealing similarly with additional works issued down to 1930

Volume 2 contains (1) a photographic reproduction of the whole of the Rhind Papyrus, including the New York fragments, on a scale of five sixths of the original size (31 photographs) , (2), on the right hand pages following the photographs, a beautiful facsimile of the hieratic text (109 plates), in which are printed in red those portions of the text which are written in red ink in the original (Peet had in his edition distinguished the red ink portions by underlining or otherwise) , (3) a hieroglyphic transcription (based on that of Peet) which is annexed to the corresponding hieratic text on each plate , (3), on the left hand pages opposite the facsimile plates, a transliteration of the text with a literal English translation interlined with it In (2), (3), (4) the red ink portions of the original text are printed in red as in (1) Accordingly, as the editors point out, from the free translation of the first volume to the original hieratic writing four steps are provided, and the portions of the original text which were written in red appear in red in each of these steps In addition, the left hand pages contain many notes (some of considerable length) on philological questions, the mistakes of the scribe, and so on One wonders with what feelings the worthy scribe Ahmes, Ahmōse or A'h mosè, who presumably never dreamt of immortality, would regard this superb setting given to his work after 3500–3600 years !

The volumes, planned on this magnificent scale, owe their appearance to the initiative of Dr Arnold Buffum Chace, who, while asking the Mathematical Association of America to undertake the publication, " generously provided the means necessary to ensure its appearance in a form commensurate with its importance ". As compared with Prof Peet, the editors had of course the advantage of being able to use the valuable work done by Mr Gunn and others as regards the text, and by other writers upon the content and the mathematical interpretation

The effect of the new editions and the extensive literature to which they have given rise is distinctly to put a higher value upon Egyptian mathematics than scholars were formerly inclined to assign to it At one time the Rhind Papyrus was classed by one school of thought as the notebook of a pupil, and not a very intelligent one at that, in view of the numerous mistakes which disfigure it But the more it was studied, the more clear it became that there was distinct method in it, as well as a high degree of skill in calculation No doubt the problems dealt with may seem to be mostly practical rather than theoretical Yet there is more science in the treatise than appears at first sight Take first the table of decompositions of fractions which we should write as $2/n$, where n is odd, into a sum of fractions with numerator unity (together with 2/3) for example, $\frac{2}{13} = \frac{1}{8}\ \frac{1}{52}\ \frac{1}{104}$, and $\frac{2}{53} = \frac{1}{30}\ \frac{1}{318}\ \frac{1}{795}$ This table, together with the numerous cases of manipulation of fractions in the rest of the treatise, raises the whole question whether the Egyptian had any general conception of such a fraction as m/n where m is any integer less than n , and it is now clear that he had, although he had no means of writing down such a fraction, and had therefore regularly to transmute it into a sum of unit fractions (with 2/3 in addition) before he could put it on paper The Egyptian regularly used, for adding together a number of his unit fractions, a process equivalent to that of reducing to a common denominator, although he uses no such term , in fact, he was able to manipulate fractions to any desired extent

The importance of prefixing to the treatise the table of decompositions of fractions of the form $2/(2n+1)$ will be readily appreciated In Egyptian arithmetic direct multiplication was limited to multiplication by 2 (rarely 10) at a time Hence the calculator would continually have to write down the result of multiplying a unit-fraction by 2 If the denominator was an even number this meant halving the denominator, simply , but if it was odd, reference had to be made to the table , the reckoner would have, say, to multiply $\frac{1}{23}$ by 2 and he would refer to the table and write down $\frac{1}{12}\ \frac{1}{276}$

Again, if we consider the grouping of the problems into classes such as (1) divisions of loaves, (2) *hau*-calculations, (3) calculations of areas (of triangles, rectangles, squares, trapezia, circles) and volumes of containers (parallelepipedal and

cylindrical), and the occurrence of questions about quantities or numbers in the abstract (for example, "two thirds added and one-third [of the sum] taken away 10 remains [find the number]"), cases of arithmetical progression and one case of geometrical progression, we cannot resist the conclusion that Egyptian mathematics had a theoretical as well as a practical side Though no theorems or rules are stated in general terms (only once does the Egyptian say, "Do the same thing in any example like this"), they can be inferred from the definiteness of the procedure followed in the particular cases

No account of Egyptian mathematics is complete without mention of the Moscow Papyrus about to be published, which contains an application of the correct formula for the volume of a frustum of a pyramid on a square base, namely, $\frac{1}{3}h(a^2+ab+b^2)$, where h is the height and a, b are the sides of the square base and the face opposite to it respectively The difficult question of how the Egyptian arrived at such a formula has already been the subject of discussion in published papers (for example, that of Peet and Gunn in November 1929), and will no doubt evoke many more suggestions as time goes on

It is agreed that the Greeks were the first to conceive the idea of making arithmetic and geometry into sciences logically developed from a minimum number of admitted though indemonstrable principles A suggestion has been somewhere made that, finding in ancient Egyptian and Babylonian documents many ready made solutions of comparatively difficult problems without a hint of any underlying theory or rules, the Greeks *had* to seek for such in order to understand the solutions, and were therefore forced to try to lay down a scientific basis The suggestion is interesting, though, even if it were true, it would not in any way detract from the Greek achievement

T L H

Chemical Engineering Economics

Einfuhrung in die theoretische Wirtschaftschemie Von Dr Rudolf Koetschau Pp xii + 155 (Dresden und Leipzig Theodor Steinkopff, 1929) 12 gold marks

CHEMICAL industry is based upon a synthesis of chemistry, engineering, and economics In the early days of chemical industry, each of these components was essentially empirical, both in outlook and method The formulation of the law of mass action and the phase rule marked the development of chemistry into a quantitative science With the help of these great principles, it became possible to define precisely the conditions which determine the successful issue of a given chemical reaction The art of chemistry became an exact science Engineering and economics also, each in its own field, gradually became more scientific

The development of a set of physical and chemical reactions into a successful and profitable industrial undertaking is beset with numerous difficulties which are not at first apparent to the chemist, the engineer, or the economist It is not until the undertaking is attempted that each realises how limited is the contribution that he can make to the common stock The process must operate efficiently, this calls for a knowledge of chemical engineering It must also operate profitably this depends upon the successful application of the principles of economics

When a successful laboratory investigation is being developed into a large scale industrial process, new and often formidable problems arise at almost every stage The minor difficulties connected with the storage and handling of large quantities of widely diverse materials can frequently be overcome successfully by the engineer with some assistance from the chemist The major difficulties are generally associated with the reaction itself Instead of controlling the reaction conditions for a kilogram of material in, say, a glass container in a well-equipped laboratory, it now becomes necessary to control with equal accuracy at every point the reaction conditions throughout a few tons of material It may be necessary to guard against slight local changes in temperature and pressure or in the composition of the materials Traces of impurities derived from some raw material or from the material of which the reaction vessel is made may vitiate the process or spoil the product It is also necessary that as much of the product as possible must possess the right degree of chemical purity and must be in the most suitable physical condition

These requirements provide problems in the design and operation of chemical plant which frequently are unfamiliar both to the chemist and the engineer The scrap heaps of our older chemical works bear witness to the empirical methods by which the chemist and engineer formerly strove together to design the most suitable form of plant The chemist and the engineer now know that mere co-operation is not enough The problems of chemical engineering must be investigated scientifically by

men who, having been trained in the principles of chemical engineering, are able to understand the precise way in which the principles of both chemistry and engineering are modified and extended by their common fusion in the melting pot of chemical industry

The process, although efficient from the purely chemical engineering point of view, has yet to be made profitable The operating conditions prescribed by the chemist and modified to meet the engineering requirements of the process must now be further modified in accordance with economic requirements The site and size of the plant, the selection of raw materials, the working efficiency and the percentage yield, the degree of purity of the product and its physical condition, the relative importance of plant costs and labour charges, all these and many other factors depend upon economic considerations When the final adjustment of the working conditions has been made and all three sets of conditions have been fused together, the final result, depending as it does upon all of them but differing essentially from each, may be stated in terms of chemical engineering economics

The formulation of the underlying theory of this complex subject is the purpose of this little book, which we have read with great interest The author, with great industry and considerable ingenuity, has attempted to co ordinate the underlying theories of chemistry, engineering, and economics in so far as they are related in chemical industry, with the object of providing a foundation upon which a rational theory and method of chemical engineering economics may be developed An attempt is made to provide a suitable notation by means of which the different sets of factors may be expressed individually Their influence upon one another and the resulting effect of their combined operation in any particular process may then be represented mathematically The book abounds in quotations from the writings of German industrialists and scientific workers, and is interesting in so far as it reflects the present trend of industrial thought in Germany It is a notable book, of interest both to the chemical engineer and the economist It provides the basis of a method by which the designs and estimates of the chemical engineer may be related to economic requirements The economist will find in it much that will help him to relate his science to the underlying chemical and chemical engineering factors which play an essential part in all industrial chemical enterprise

W E G

Trade Rivalry and World Peace.

America Conquers Britain a Record of Economic War By Ludwell Denny Pp xi + 429 + xvi (London and New York Alfred A Knopf, 1930) 12s 6d

MR LUDWELL DENNY'S book is the most complete, well documented, and interesting account of American and British rivalry in trade and finance that has yet appeared It deserves close study, especially by all believers in growing international friendship, because, although the facts it describes are all capable of pacific settlement, they contain much dangerous explosive material and have in the past been treated far too carelessly They are also in large part of quite recent growth

The author's avowed theme is the economic victory of the United States It gives a spice to the book and will commend it to American readers who may follow breathlessly the story of the rise and penetration of a flood of American capital all over the world ' Our weapons are money and machines But the other nations of the world want money and machines Our materialism, though not our power, is matched by theirs That is why our conquest is so easy, so inevitable " As to England, " She is an over populated, dependent, exposed island As a major world Power, her days are numbered "

One might remark, in passing, that this melancholy conclusion is not quite in keeping with the general thesis and the manifold and startling findings of the book From these we gather—and the author is constantly enforcing this conclusion—that the United States and Great Britain (meaning, of course, the whole British Commonwealth, so far as it acts as one) are waging a titanic combat for the mastery of the world They and we are in the foreground of the picture and the rest are almost nowhere If this be so, how can he at the same time represent Great Britain as fallen from the rank of ' major powers ' ? Which are the other ' major powers ' which have taken her place ?

This may, however, be considered rather as a debating point, it is the larger issues which call for most attention Looking at the facts rather from the world point of view, what strikes one most is the pervasion of the whole world by giant financial interests which are insistently acquiring and attempting to control the materials and means of life necessary for our modern civilisation It is on this side that Mr Denny's review is so enlightening, and in one sense so disquieting We see rubber, oil, chemicals, cables, radio communication,

air routes, shipping, being fought for and, so far as possible, monopolised by huge trusts and mergers in which from time to time nationalist animosities blaze out and national governments take a part, but which on the whole are governed by financial considerations This would be the conclusion of any fair minded survey of the multitude of facts which Mr Denny presents, and he admits it himself in the sentence quoted above So far as America has 'conquered' Britain, or any other part of the world, it is by virtue of her wealth, size, population, and collective resources, not by the exercise of any deliberately hostile act or intention This is why the constantly warlike language and analogies of the author are to be deprecated Economic motives, no doubt, had some place in the War, but it would be a wild misreading of history to regard them as the most important, and in the future a real war, arising from the economic war' described in the book, is still less to be expected If anyone is inclined to think this a piece of 'facile optimism', he should remember that practically all the trusts and mergers have money from many nations, that the two leading rivals, America and Great Britain, work side by side on many of them, and that the oil kings and rubber emperors, men like Sir Henri Deterding, are more and more international figures

Still, the facts are extraordinarily interesting and serious, the more so because they are mostly of such recent date most of the developments described are post War But though the facts are so complicated, two simple morals will be drawn by the plain, well-meaning man The first, that it is not an unmixed evil that there should be some competition between the purveyors of oil and potash and rubber and tin, things that are increasingly needed in a modern State That there should be an absolute monopoly would be quite intolerable The second, that the spread of world-wide financial influences makes more and more urgent the strengthening of a world authority superior to them—the League of Nations and cognate bodies, representing and reconciling the interest of all What the United States has done at home to curb the tyranny of trusts must be done internationally in so far as the trusts become strong enough to threaten the well-being not so much of rival governments but of the struggling consumers for whom they exist Some of the great interests mentioned, aviation, for example, and radio, would seem to be eminently suitable for international control.

F. S. MARVIN.

Human Speech.

Human Speech some Observations, Experiments and Conclusions as to the Nature, Origin, Purpose and possible Improvement of Human Speech By Sir Richard Paget, Bart (International Library of Psychology, Philosophy and Scientific Method) Pp xiv + 360 + 6 plates (London Kegan Paul and Co, Ltd, New York Harcourt, Brace and Co, 1930) 25s net

SIR RICHARD PAGET began his researches into the nature of human speech as follows " Being alone in London, confined to bed with a slight chill, and disinclined to read, it occurred to me to try and listen to the whispered resonances of my own voice, as I had begun to do during the War " He required no other apparatus than a pencil and paper, for, although without the gift of 'absolute pitch', he can produce notes of 812 and 966 vibrations per second by tapping his skull in certain places These he used as standards throughout his researches He listened with such intensity to his whispered vowels as to produce a feeling of sickness Gradually the power to recognise each resonance was acquired The first product was a chart of vowel resonances more complete than any hitherto produced

By adding plasticine, tubes of cardboard, glass and rubber, cork, clips, and other similar inexpensive means to his experimental equipment, Sir Richard Paget was able to accumulate the material for three Royal Society papers, which carried the whole matter much beyond the point attained by previous investigators, and are now recognised the world over as fundamental All the sounds of speech have been dealt with in the course of his work

'Sound, light, heat, magnetism and electricity' were the old pedagogic divisions of the science of physics the least of these, though named first by some freak of fortune, was sound Even the invention of telephone and phonograph failed to attract more than a negligible proportion of students into the domain of sound research War and peace, sound-ranging and talkies, have changed all that An army of investigators equipped with apparatus of the highest refinement is busy in America Their results have confirmed those of Sir Richard Paget We may be excused a certain pride and æsthetic pleasure in the elegant simplicity and genial intuition of our countryman, so truly in the tradition of our native scientific genius. We do not thereby

admit vicarious ascetic virtue in our financiers who leave our pioneer workers austerely devoid of the expensive equipment showered upon their colleagues abroad

It would seem that, in many branches of industry those who hold the purse strings are willing to plead safety first and relinquish our pride of place in industrial invention They are willing to pay heavy tribute to other countries particularly America and Germany for inventions frequently based upon the pioneer work of Englishmen The situation would be less deplorable if the money subscribed by the public to industrial undertakings were in fact always used with the maximum of economy and safety On the contrary it has recently been used especially in this particular field in so criminally careless a manner that no more is forthcoming at the present time

We may expect that so fertile a mind capable of tackling a very old subject with prodigality of invention and economy of means will range a good deal farther than the mere setting down of the facts ascertained We are not disappointed Sir Richard Paget s researches are for him a means to an end—not better and brighter talkies but the improvement of language and speech based upon a full understanding of its mechanism and origin Speech is effected by movements of parts of the oral cavity which movements our ears recognise even when the actual sounds transmitted to the ears as a result of them vary very much from time to time The oscillograph record of a word as whispered voiced or sung by various people will be very different but the oral movements are essentially the same

How do these movements arise? The theory which Sir Richard Paget has made his own (though foreshadowed by others whose work is here referred to very fully) is as follows the movements were originally descriptive gestures, analogous to those made by the more visible parts of the body in sign language, which probably preceded speech These movements tend to arise along with sign language, quite unconsciously. the schoolboy, painfully striving to write neatly, follows his pen with his lips and tongue We see the gestures of sign language with our eyes, which fail us in the dark, but we can see the gestures of our oral cavity with our ears hence the superiority of such gestures

This theory is worked out with skill, ingenuity, and a wealth of illustration, which make this part of the book absorbingly interesting The work of the only noteworthy and specific forerunner, Dr J Rae, is printed in full This is welcome for the original appeared only in a paper called *The Polynesian* published in Honolulu in 1862 and hence is not very accessible though most entertaining

The value and scope of Sir Richard Paget s researches confer upon the author every right to give us some advice as to how they may be turned to practical account Those in search of a commercial proposition may consider the construction of a talking automaton or robot which would have the greatest value for teaching purposes Teachers and students of elocution and singing will find abundant matter in the chapter on voice production Finally there is a strong plea for conscious effort towards the improvement of our language in every respect—form grammar pronunciation and orthography We are competent for the task now that we know so much about it physically and historically The endeavours of devoted and enthusiastic people to popularise artificial languages for international communication seem destined to make little further progress, while English continues to spread rapidly There can be little doubt that it will finally become the medium of international understanding and we shall be doing a great work in making it as perfect an instrument as possible

Sir Richard Paget appeals in his work for the development of a centre for the study of the relations of thought and speech such a centre already exists as he points out in the Orthological Institute under the direction of Mr C K Ogden and is engaged in investigating these problems and in applying the results to the simplification of English for practical international purposes Sir Richard Paget would have us go further with such pioneers and casting aside custom and tradition get down to fundamentals transform our language by conscious effort into a more efficient means of expression as well for the uses of art as for those of science and commerce

The book is enriched with other valuable features —a discussion of notation, a mathematical exposition of the double resonator theory by Mr W E Beaton copious references, an adequate index Altogether a worthy addition to the International Library of Psychology, Philosophy and Scientific Method, that bright star on the firmament of British publishing enterprise

H S H

Our Bookshelf.

Recent Advances in Preventive Medicine By Dr J F C Haslam With a chapter on the Vitamins by Prof S J Cowell (The Recent Advances Series) Pp viii + 328 + 6 plates (London J and A Churchill, 1930) 12s 6d

This volume of the series describes 'recent advances' which are so modern that many of them might more aptly be said to constitute new departments of preventive medicine The space allotted to each subject is so small that only a very condensed account can be given, but this is done without either obscuring the meaning or presenting an uninteresting catalogue of facts and theories The nine chapters which deal with different branches of hygiene contain information only acquired in the last five or ten years on subjects the very names and substances of which did not exist twenty years ago

Since matter of such recent date has been chiefly selected for treatment, the more gradual advances in other departments have of necessity been omitted Dr Haslam has included a notice of the difficult problems of practical eugenics and the various experiments which have recently been made He expounds the most diverse themes from infantile mortality and nursery homes to the methods of investigating the excessive mortality of compositors from consumption, and the means of acquiring active immunity to diphtheria and scarlet fever The causes and prevention of dental caries are well and judiciously discussed and the real knowledge gained clearly set out The effect of atmospheric conditions on health and their study by the use of the kata thermometer are interestingly discussed in 22 pages The effect of psychological and other personal characteristics on the incidence of industrial accidents is among the subjects considered in the survey Prof S J Cowell in 30 pages on vitamins gives a very lucid account of the rapid advance and definite knowledge attained in this still actively growing field of research

The book affords not only a pleasant means of obtaining a glimpse of so much that has been learnt of late in preventive medicine, but also provides a very useful list of books and papers from which more detailed information on the separate subjects can be obtained

Modifications in Indian Culture through Inventions and Loans By Erland Nordenskiöld (Comparative Ethnographical Studies, Vol 8) Pp v + 256 (London Oxford University Press, 1930) 18s 6d net

Baron Erland Nordenskiöld's "Comparative Ethnographical Studies" have confirmed rather than won for him a standing as the foremost authority in the study of the Indians of Central and South America His latest volume in the series has an added value in that it is a much desired contribution to the study of the 'diffusion' question, which relies upon an examination of detail and not upon generalised conclusions Incidentally and as a matter of secondary interest, several sections might serve as demonstrations of the method of technological study

Indian culture is here treated in various aspects The first section deals with Indian invention and discovery in the pre Columbian period, one of the most significant points being an apparent readiness to experiment in the utilisation of natural products In a lengthy list of such discoveries, maize, the sweet potato, manioc, tobacco, coca, and cocoa are the most familiar Perhaps the most remarkable and significant invention, however, is that of bronze, which, the author maintains, must be regarded as an element independent of the Old World This, however, is one only of a number of inventions which the author concludes must have arisen independently in the New and the Old Worlds In this connexion and in view of the discussion which has taken place on the origin of the Maya civilisation, it is remarkable that the Maya calendar and system of writing have no exact parallels elsewhere

As a whole, this volume is a valuable contribution to the study of a difficult problem It is only by such detailed studies as this that we are likely to arrive at the truth It serves to demonstrate that only a most exact comparison of detail can afford a sound basis of argument Generalised statements may appear to afford support for theory, but too often it vanishes when a more exacting search is made for correspondence in detail

(1) *Science and Mathematical Tables for Use in Schools* Arranged by W F F Shearcroft and Denham Larrett Pp vi + 33 (London Sir Isaac Pitman and Sons, Ltd, 1929) 1s

(2) *Cambridge Five Figure Tables* By F G Hall and E K Rideal Pp viii + 76 (Cambridge At the University Press, 1929) 3s 6d

(3) *Seven Place Natural Trigonometrical Functions together with many Miscellaneous Tables and Appendices on the Adjustment of the Engineer's Transit and Level, Area Computation, Vertical Curves, Simple Curves, and Determination of Latitude, Longitude, and Azimuth* By Howard Chapin Ives Pp v + 222 (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1929) 12s 6d net

(1) This is a clearly printed set of four figure tables of logarithms, antilogarithms, natural and logarithmic sines, cosines and tangents, together with some formulæ and physical constants

(2) The main contents are logarithms of numbers from 1,000 to 9,999, natural and logarithmic sines and tangents for each minute of arc The tables are arranged on a novel and interesting principle The arguments are in descending order of magnitude, so that each tabular entry is greater than the following one This arrangement facilitates the formation of differences, since the numbers are in the most suitable position for subtraction The type is very clear and well spaced

(3) These seven place tables give six natural trigonometric functions for each minute of arc,

versed sines, external secants, chords, circular arcs, and miscellaneous tables, formulæ and appendices of interest mainly to surveyors and railway engineers It is rather difficult to see any reason for tabulating external secants (sec $x - 1$) in a book which already contains a table of secants No differences are given, and this, together with the closeness of the printing, makes the tables somewhat difficult to use L M M T

Field Book of Marine Fishes of the Atlantic Coast from Labrador to Texas, being a Short Description of their Characteristics and Habits, with Keys for their Identification By Charles M Breder, jr (Putnam's Nature Field Books) Pp xxxviii + 332 + 16 plates (New York and London G P Putnam's Sons, 1929) 15s net

THIS little volume, more or less of pocket size, is designed primarily to meet the needs of the amateur outdoor naturalist, its main purpose being to enable a worker with the minimum of technical knowledge quickly and easily to identify any species of fish likely to be found in the area treated The author therefore begins by defining what is meant by the term fish, and describes briefly their general manner of life A short chapter is devoted to descriptions of the various types of environment included in the region under survey, which extends from the cold boreal waters of Labrador through the temperate seas of the Atlantic seaboard of America down to the warm tropical waters of the Gulf of Mexico An offshore limit has been set at the twenty five fathom line, and the brackish water zone marks the shoreward limit up streams and estuaries The greater part of the book is devoted to analytical keys and descriptive matter Keys are given to enable the worker to place his fish successively in its correct order, family, genus, and species Further to facilitate identification, an outline drawing of nearly every species is given, with an appended short note on its range, habits, relative abundance, and average adult size

There is a fairly comprehensive glossary of technical terms and a short bibliography

Leçons sur la théorie des tourbillons Par Prof Henri Villat (Institut de mécanique des fluides de l'Université de France) Pp v + 300 (Paris Gauthier-Villars et Cie, 1930) 65 francs

PROF VILLAT'S treatment of vortex motion has both the virtues and defects which are usually found in French treatises on mathematical physics The mathematical treatment is clear and logical, and presented in an attractive style On the other hand, although the lectures on which the book is based were delivered at an institute founded by the Ministry of Air, we have scarcely any reference to experimental data There is one oasis in the desert of mathematical symbols (p 80), where we read that a cylinder moving in liquid is really found, in certain circumstances, to set up two series of vortices closely conforming to those calculated by Bénard With this exception, the book suggests that the author cares much for mathematical analysis and little, if at all, for real fluids However, if we accept his point of view, there can be no question as to the quality of the work After an exposition of the classical results, we have a good account of more recent work, in particular that of Bénard, Synge, Rosenhead, Caldonazzo, Riabouchinsky, and Lichtenstein The last chapter uses Oseen's integral equation to discuss vortices in a viscous fluid

H T H P

Opera By Richard Capell Pp 80 *Libraries and Museums* By Sir Frederic Kenyon Pp 79 *Banking* By W W Paine Pp 80 (Benn's Sixpenny Library, Nos 99, 100, and 108) (London Ernest Benn, Ltd, 1930) 6*d* each

THE provision of inexpensive 'libraries' is not a new feature in England Prof Henry Morley long years ago edited a 9*d* library of classical literature and a 3*d* library of general literature, in each case the volumes issued were standard works, mostly of earlier date than the nineteenth century The present library proceeds upon a different basis, seeking individual authors to deal with some special subject Mr Capell in "Opera" has an interesting theme, which in the earlier portion of the book is overloaded by a flamboyant style of writing which detracts from the pleasure that a reader may experience Sir Frederic Kenyon's remarks upon libraries and museums are well worthy of attention, and his rapid survey of the centuries is alluring But he is mistaken in stating that Merton College Library, Oxford, is a fifteenth century building, as it is fourteenth century Perhaps Mr Paine's "Banking" is the most engaging of the books under notice, his treatment is masterly in its presentation—in a manner truly captivating—of what might easily prove dry as dust to the lay public P L M

Horological Hints and Helps By F W Britten (Lockwood's Manuals) Pp xi + 327 (London Crosby Lockwood and Son, 1930) 7*s* 6*d* net

THIS volume is addressed more to the young practitioner than to the novice, as it assumes a certain minimum of actual acquaintanceship with horology, in the absence of which the book would prove difficult to follow That the author is proud of being his father's son is made pleasantly clear from the reference on the title page After dealing at sufficient length with general horological work, the remaining pages are distributed between watches and clocks That Mr Britten understands his subject from the dial plate and hands down to the very least screw is abundantly evident, but the book is entirely lacking in any graces of literary style It may be granted that knowledge is the quality to be preferred, but a work of art exhibits something more than mere technique, in truth, the latter is better shown by concealment There are numerous diagrams, and these would have been better had some idea of limiting dimensions been given, or had the amount of magnification been stated It would be difficult to select any one part of the book as being more valuable than any other, where all is so practical and masterly P L M.

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

Stark Effect in the Ultra-violet Spectrum of Neon.

THE ultra violet spectrum of neon consists of the lines belonging to the principal series of the arc spectrum and the lines of singly and doubly ionised neon To obtain the Stark effect for these lines it is essential to increase the field strength for the lower members and the intensity for the higher members The spectrograph used was the Steinheil Q D type The field stength was determined from helium lines

It was found that sixty lines of the principal series are affected, and these practically include the most important lines As an illustration, the accompanying photographs are reproduced (Fig 1) Most of these lines are deflected toward the negative side, but six of them are deflected toward the positive Some of the higher members accompany the *sd* combination lines, which in turn are slightly deflected in the same direction as the associated principal series lines It is remarkable how these *sd* combination lines appear As the figure illustrates, the *sp* lines lose their intensities almost abruptly at about the same field strength as the *sd* lines appear, so that they can be recognised only with caution The discontinuity of the intensity (that is, *sp-sd*) shifts toward the upper part of the spectrum with increase of the maximum field strength as expected (the field strength being distributed in the same spectral length, the point corresponding to the same field strength would shift toward the upper part as the maximum field is increased) Another remarkable feature is that Pashen's $1s_2 - mp_1$ series suffers a change of sign (in the electrical deflection) at $1s_2 - 4p_1$ and then regains the original positive sign as m increases (for $1s_2 - 2p_1$, +)

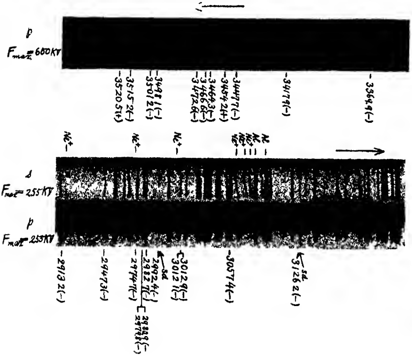


FIG 1

As regards the spectrum of ionised neon, it is a peculiar fact that the affected lines are very weak in intensity at low electric fields, and disappear altogether in high fields, the optimum field being in the interval of 120 250 k v per cm The presence of helium tends to reduce the intensity of the ionised neon in general, but with these affected lines it is very decidedly so, for with helium they totally disappear These lines are deflected to the positive side, and most of them accompany combination lines at the more refrangible side, the deflections of which are negative, the magnitude being nearly as large as that of the associated lines All the affected lines are grouped in the range λλ2915 3123 The non combination lines were recorded by Bloch [1] but were not investigated by the Bruin [2] system Tho lines considered by Bruin are scarcely affected and they, too, disappear in high fields The effect on the doubly ionised neon is uncertain at present

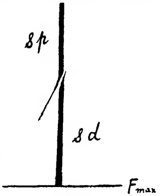


FIG 2

Both groups of the affected lines are only slightly polarised Details will be published in the Scientific Papers of this Institute

YOSHIO ISHIDA

Institute of Physical and Chemical Research, Tokyo, Japan

[1] L Bloch, E Bloch, and G Déjardin *Comptes rendus*, vol 180, No 10 p 131, 1925

[2] T L de Bruin *Zeit f Phys*, vol 46, p 856, 1928

Stability in Soap Films

SOAP films exhibit a stability (permanence and mechanical strength) which is without parallel in films of water or other pure liquids which contract almost instantaneously to spherical droplets under the influence of surface tension In a letter to NATURE of May 31, p 815, Mr Green attributes this stability to "stratifications almost certainly pervading the whole film". This conclusion is directly opposed to the view, now widely held, that soap films have a 'sandwich' structure, as I have called it (*J Phys Chem.*, **34**, 263; 1930), that is, that they consist of a pair of surface layers adsorbed at the liquid/air interface and enclosing a layer of liquid, identical in composition with the channel of liquid around the boundary of the film and its rigid support (often called the Gibbs' ring) and with the solution from which the film was made In reply to Mr. Green's contentions,

there is no evidence that soap films have greater stability than is to be expected from the sandwich structure There is no reason to suppose that any degree of strength would result from the structure suggested by him, nor that such a structure exists except in abnormal and rare cases The evidence for these opinions is as follows

1 The number of bimolecular stratifications—of molecules of molecular weight 300 and occupying an area of 20 A U sq —which could be formed in a film 1000 $\mu\mu$ thick of 5 per cent soap solution is only 10 That is, the stratifications would be some 100 $\mu\mu$ apart It is useless to postulate "powerful but labile forces" to act over these distances, and the figures show that *no close packed arrangement of molecules in the interior of a soap film can account for enhanced mechanical strength* In any event, the thinning of a film which had such a structure would seem to require the destruction of the structure which is being suggested as essential for its continued existence! The conclusion that "the disruptive action of surface tension is overpowered by structural cohesiveness" takes no account of the origin of surface tension and its mechanism Disruption occurs under its influence when soap molecules are being pulled (by molecular attraction) from the surface layer into the interior at a faster rate than they can be replaced

I explain the checking of this disruptive tendency of surface tension by

(a) The lateral cohesion of the oriented molecules of the surface layers of the 'sandwich'

(b) The presence of a reserve of adsorbed solute just beneath the surface layer and ready to fill any vacant places in it

It is obvious that the "powerful but labile" forces postulated by Mr Green as acting between his stratifications must be an inward pull on the surface layer additional to surface tension, and therefore a serious source of weakness and not of stability at all

2 *There is no evidence that stratification of the interior of a soap film is of general occurrence* The term 'stratification' when applied to soap films has a definite significance (see Perrin, *Annales de Phys* (9), **10**, 165, 1918 P V Wells, loc cit (9), **16**, 79, 1921 Also Lawrence, "Soap Films", p 58, 1929) The sharp boundaries of coloured bubbles cannot be interpreted in this way, since the steps up in thickness are from 12 to 20 times that of the bimolecular layer The suggestion that these discontinuities result from aggregation of the molecules under the perfectly quiet experimental conditions ignores the fact that such conditions do not mean a cessation of the kinetic motions of the molecules in question It is more likely that these boundaries are due to colloidal soap threads which may well be responsible also for the persistence of inequalities of thickness, since their long flexible form will enable them to act as boundaries retarding free mixing

3 *Stratification of soap films containing a fluorescent substance is the formation of a new phase* We have no right to regard the interior of the soap film as in any way different from the solution of which it was once a part, *unless some definite change can be shown to have occurred.* No attempt has been made to explain the mechanism of stratification As we have already seen, a film 1000 $\mu\mu$ thick of 5 per cent soap solution can only yield 10 bimolecular layers, hence the maximum thickness of the resultant stratified film from one of this thickness should be 42 $\mu\mu$ (or less) Actually, however, brightly coloured stratifications will be observed 10 or more times as thick The extra solute comes from the Gibbs' ring and its extrusion is clear (see frontispiece of "Soap Films") It appears that, under the influence of light upon a soap film containing a fluorescent substance, molecules of soap separate at the face nearer to the source of illumination, these then link up with the surface layer of molecules, already oriented there, to form a bimolecular layer, the molecules being associated by their carboxyl extremities and therefore no longer soluble nor surface active Fresh solute will therefore be adsorbed, but only to be transformed in turn until the supply from the Gibbs' ring is exhausted The process is quite similar to the formation of Grandjean's terraces of liquid crystalline substances on an initially oriented layer of molecules I have not the space to go further into the matter—how, for example, the fluorescein can bring about this change—but there is no doubt that we are dealing with the formation of a new phase It is, in fact, a crystallisation I may add that a completely stratified film of the sort discovered by Perrin, in which the stratifications are close together and not separated by large distances as Mr Green's hypothetical ones are, has a mechanical strength apparently vastly inferior to that of a liquid film

This explanation of the rôle of the Gibbs' ring, coupled with the fact that all the stratified films hitherto studied have been very small ones, shows that Mr Green's suggestion that the 'stratifications' in large bubbles are due to the absence of disturbance from the Gibbs' ring is another argument against their being true stratifications at all

4 There is the final possibility of the occurrence of flakes in colloidal solution so that their presence in a soap film would not involve the formation of a new phase This, however, seems quite remote, since the characteristic form of the colloid particle in all soap solutions is the long thread, possibly the zigzag form and absence of radial symmetry of the molecule chain is the reason why colloidal lamellæ do not exist On the other hand, where soap separates from molecular dispersion by association of the carboxyl groups, the resultant form is always lamellar (Darke, McBain, and Salmon, *Proc Roy Soc*, A, **98**, 395, 1921 Also Lawrence, *Koll Zeit*, **50**, 12, 1930) It is clear then that the *ordinary soap solution contains no stratifications and that they only appear as a new phase*

I have no space to discuss blackening as the formation of a new phase, but I hope to deal with this and the whole question of the thinning of coloured films and to give an explanation of the hitherto inexplicable sharpness of the black boundary in a future publication

A S C LAWRENCE

Laboratory of Physical Chemistry,
Cambridge, June 8

The Striated Discharge

IT is well known that the striation separation in the electrical discharge in gases varies with the radius of the discharge tube and the pressure of the gas The exact relation between these factors was first investigated by Wehner (*Ann der Phys*, **32**, p 49, 1910), who gave as a result of experiments with hydrogen and nitrogen the relation

$$S = C\,\frac{r^{1-m}}{P^m}$$

where S is the striation separation in mm, r the radius of the tube in mm, and P the pressure of the gas in mm of mercury C was a constant for both gases with a value of approximately 2, and m a constant which varied with the nature of the gas For hydrogen, $m = 0\ 53$, and for nitrogen, $m = 0\ 32$ Further experiments were carried out by Neubert (*Ann der Phys*, **42**, p 1454, 1913), in which he used hydrogen free from any impurities and found the same law to hold

The results of a series of experiments by us on the same topic, using different gases, have led to a modified form of the Wehner-Goldstein law In these experiments a set of five discharge tubes was arranged so that the tubes were all connected in series Each tube had plane aluminium electrodes nearly filling the cross section of the tube The internal radii were approximately 1 4, 2 6, 4 0, 5 3, and 6 5 cm respectively, and the tubes were all about 78 cm long The current density was kept the same in each tube

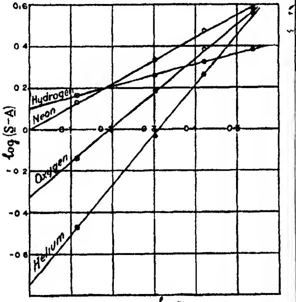


FIG 1

and the pressure adjusted until steady striations could be obtained in at least four of the tubes An Evershed and Vignolles direct current generator was used as a source of current The gases were pure except for contamination with mercury vapour from the McLeod gauge and from the mercury diffusion pump which was used to exhaust the system The five tubes were then all filled with the same gas at the same pressure The results of experiments with hydrogen, oxygen, helium, and neon indicate that the law for the variation of striation separation with the radius of the tube is given by

$$S = A + C\ r^n$$

where A and C are arbitrary constants depending upon the nature of the gas A typical set of results for these gases is shown in the accompanying diagram (Fig 1), where log $(S - A)$ is plotted as ordinates and log r as abscissæ The value of the pressure P was constant but different for each gas For hydrogen A is zero, thus agreeing with Neubert's result The values of n and C appear also to depend upon the amount of mercury vapour present The current density in each case was 0 28 milliamp /cm ^{2}, and the equations giving striation separation for each gas for the pressures used are given in the following table

Gas.	Pressure in mm Mercury	Striation Separation S in Terms of Radius of Tube r in mm
Hydrogen	0 21	$s = 1\ 26\ r^{0\ 52}$
Neon	0 16	$s = 0\ 95 + 1\ 1\ r^{2\ 1}$
Oxygen	0 07	$s = 1\ 2 + 0\ 48\ r^{1 \cdot 5}$
Helium	0 51	$s = 1\ 6 + 0\ 18\ r^{2\ 2}$

An interesting investigation by Prof John Zeleny on the variation of striation separation with pressure has just appeared in the *Journal of the Franklin Institute* for May In our experiments the pressure was kept constant, but the same law appears to hold for different pressures For example, in the case of helium the equations for the different pressures were found to be as follows

Pressure in mm of Mercury	Striation Separation in mm
0 38	$s = 1\ 5 + 0\ 55\ r^{1\ 5}$
0 53	$s = 1\ 6 + 0\ 64\ r^{1\ 5}$
0 67	$s = 1\ 4 + 0\ 23\ r^{2\ 5}$

A full account of this investigation will appear later, and further experiments will be done with tubes free from mercury vapour

D A KEYS
J F HEARD

Macdonald Physics Laboratory,
McGill University, May 10

Mortality amongst Plants and its Bearing on Natural Selection

THE interest for the theory of natural selection of the researches on the mortality of seedlings reported by Dr E J Salisbury (NATURE, May 31) is so great, as is, in all its aspects, the development of a quantitative ecological technique, that it seems important not to allow the interpretation of the new observational material to be prejudiced by the use of an argument which contains a concealed fallacy This argument could not be more briefly stated than in Dr Salisbury's words, "The mortality and therefore the operation of natural selection is almost entirely confined to the juvenile stages of development"

It may be recalled that this same argument was used by Wallace as a reason for rejecting the application of the theory of sexual selection to butterflies ("Darwinism", p 296) "In butterflies the weeding out by natural selection takes place to an enormous extent in the egg, larva, and pupa states, and perhaps not more than one in a hundred of the eggs laid produces a perfect insect which lives to breed Here, then, the impotence of female selection, if it exists, must be complete" Wallace, however, did not apply this argument to a second case to which evidently it is equally applicable, for he has no hesitation in advocating the development of *protective* coloration by the natural selection of adult butterflies (*ibid*, p 207)

I believe the most useful step in examining the nature of this fallacy is to realise that, when mortality is heavy, immature forms of different ages are not of equal value, in the purely objective sense that they will not be equally represented in the ancestry of future generations Knowing the rates of death and reproduction at all ages, it is possible to calculate the reproductive value, in this sense, at each age, and the course of this function for ages prior to the commencement of reproduction, is, in a stationary population, easily seen to be inversely proportional to the number living at each age If, therefore, starting from the seed, we have three stages of development, A, B, and C, to which 1 in 10, 1 in 100, and 1 in 1000 seeds actually attain, single individuals at these stages will be worth, in respect of their probable contribution to future generations, just 10, 100, and 1000 times respectively as much as the newly shed seed is worth The selective elimination of certain individuals at stage C is for this reason as effective in modifying the genetic constitution of the species as the selective elimination of 10 times as many individuals at stage B, or of 100 times as many at stage A, or of 1000 seeds in their initial condition

The concept of reproductive value seems to provide a powerful method of resolving many of the paradoxes which have arisen in Darwinian discussions. It is easy by its means to show in what circumstances, and for what reasons, such widespread assumptions as that the death rate is a more important selective agency than the birth rate, or that selection is most intense at times when the death rate is highest may be in fact very far from true. The prospect of determining the vital statistics of wild populations, with sufficient accuracy to establish the relative values of different stages of development, is one of the most attractive features of the quantitative method in these fields.

R. A. FISHER.

Rothamsted Experimental Station,
Harpenden, Herts,
June 2.

THE interesting and valuable letter of Prof. Salisbury on the subject of "Mortality amongst Plants and its Bearing on Natural Selection", which appeared in NATURE of May 31, cannot be allowed to pass without comment, as the issues which it raises are fundamental. Prof. Salisbury finds that amongst plants it is in the seedling stage that the unfit are eliminated and that there is no evidence that little peculiarities of form which are manifested only in the adult condition have any bearing on survival at all. What determines the survival of a seedling is its *vigour of growth*, not peculiarities of its morphology. Prof. Salisbury does not touch on the causes of these differences in vigour, and doubtless in every particular case a special investigation would be required to determine them.

My purpose in writing this letter is to direct attention to the fact that similar differences in vigour are to be seen in the eggs of animals and that some light has been thrown on the causes of these differences.

In a recent paper ("General Physiology of Development of Simple Ascidians", *Phil. Trans. Roy. Soc.*, Series B, vol. 218, 1930), Mr. N. J. Berrill, lecturer in comparative physiology in McGill University, describes *inter alia* his investigations into the causes of the differences of vigour among ascidian tadpoles. He finds that these are referable to the length of time that the eggs remain in the oviduct and the toxicity of the oveducal fluid.

Thus natural selection only weeds out the feeble and diseased and by no stretch of the imagination can be regarded as capable of giving rise to anything new.

In conclusion, I may mention a typical experience which we ourselves have experienced in the zoological laboratory of the Imperial College of Science this year. On two occasions we have had sent to us from Plymouth living *Echinus miliaris*. On both occasions the animals arrived alive, and males with active sperm and females with ripe eggs were found among them. On the second occasion we received the specimens within fifteen hours of their leaving Plymouth, and from them we have raised three vigorous cultures of exceptionally healthy larvæ. On the first occasion, however, through an error on the part of the G.W.R. officials, thirty-six hours elapsed before the specimens reached us. The eggs, though apparently normal, reacted feebly to fertilisation and admitted numerous spermatozoa, with the result that the vast majority had cytolysed by next morning. A few apparently normal larvæ were produced, but these all died off in about a week for no obvious reason but feebleness of constitution.

E. W. MACBRIDE.

43 Elm Park Gardens,
Chelsea, London, S.W., June 6.

The Thermo-Electric Properties of Ferromagnetics.

IT has long been known that there are peculiarities in the thermo-electric power curves of the ferromagnetic metals. Fairly recently Dorfman, Jaanus, and Kikoin (*Zeits. fur Phys.*, 54, 277; 1929) have measured carefully the thermo-electric power of nickel against platinum over a range of temperatures in the neighbourhood of the Curie point of nickel. The variation is such as to indicate a fairly sudden change in the 'specific heat of electricity' for nickel at the Curie point. The magnitude of the change in the specific heat per electron, ΔC_e, is of the same order as the change in the specific heat per atom, ΔC_a, determined in the usual way. From this point it was concluded that the magnetic 'carriers' could be identified with the conduction electrons, although this does not fit in with other evidence.

For some time I have suspected that the sign of ΔC_e was given incorrectly, but the trickiness of signs is such that I have felt doubtful about my own conclusions. I have, however, recently had a letter from Dr. Dorfman (dated May 16) in which he tells me that a mistake was made in his paper. The magnitude of ΔC_e was given correctly, but the signs of ΔC_a and ΔC_e are opposite. This renders the previous conclusions untenable. So far as I know no explanation has been given of the modified result, of which I would like to suggest a tentative interpretation.

For approximate purposes, the specific heat of electricity per electron, C_e, may be defined as the change in specific heat of the metal due to the addition of one electron. The suggestion I wish to put forward is that the relation of the change in C_e in passing through the Curie point to the change in the atomic heat, C_a, depends on the number of electrons required per atom to convert the substance from a ferromagnetic to a non-ferromagnetic state, in which there is no additional 'magnetic' specific heat. If one electron per atom is required, ΔC_e should be equal and opposite to ΔC_a. More generally, if n electrons are necessary, the relation would be

$$n\,\Delta C_e = -\Delta C_a$$

Dorfman's results give for n the value 0·78 for nickel. If the nickel atoms were converted into copper-like ions, the assembly would be non-ferromagnetic. The result suggests, in agreement with other evidence, that less than one electron per atom is required to produce a non-ferromagnetic state. Moreover, if this interpretation is on the right lines, it indicates that the ferromagnetic properties of nickel are to be traced to a deficiency of electrons from complete groups rather than to an excess of electrons.

This brief outline will probably be sufficient to indicate the general nature of the suggested interpretation of Dorfman's experimental results.

EDMUND C. STONER.

Physics Department,
University of Leeds,
May 26.

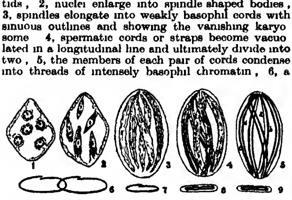
Multiple Spermatozoa and the Chromosome Hypothesis of Heredity.

IN 1928 I published (*Annals of the Natal Museum*, vol. 6, pt. 1) a short account of some observations indicating the production of more than one spermatozoon from a spermatid in the case of two Natal spiders, *Evarcha natalensis* and *Saitis leighi*. The conclusions then arrived at have now been confirmed by a more detailed examination of the spermiogenesis of an unnamed species of *Evarcha*.

The facts would seem to have considerable interest in their bearing on the hypothesis that hereditary

characters are transmitted by specific particles of chromatin incorporated in the chromosomes at definite sites

Very briefly to summarise the observations, we have, in the accompanying figure, 1, lobule of spermatids, 2, nuclei enlarge into spindle shaped bodies, 3, spindles elongate into weakly basophil cords with sinuous outlines and showing the vanishing karyosome 4, spermatic cords or straps become vacuolated in a longitudinal line and ultimately divide into two, 5, the members of each pair of cords condense into threads of intensely basophil chromatin, 6, a



pair of threads separating from each other and becoming spirally curved, 7, shrinkage of spermatozoon, 8, 9, formation of capsule Thus a lobule produces about twice as many spermatozoa as spermatids

The longitudinal splitting of the cords is far from being a regular process, sometimes it is not in the mid axis, and one member of the pair (5) is thin (*a*) and the other thick (*b*), while at other times the two members may be more or less similar to each other (*c*, *d*) In this connexion it must be added that in the genus *Saitis* there is a strong evidence that three, or even more, spermatic threads may arise from a single spermatic strap All the chromatin threads, whether relatively thick or thin, appear to form perfectly normal spermatozoa

From the very exacting nature of the chromosome hypothesis with the enigmatical genes arranged in serial order along the chromosomes, it would seem to be essential that the spermatic cords should split with mathematical accuracy into identical halves, but the processes outlined above are altogether inconsistent with any great precision in the subdivision of the chromatin substance in the formation of the spermatozoa

A detailed account of the observations will be published shortly, and in the meantime, granting their validity, it would be very interesting to hear how it is proposed to reconcile them with the current chromosome hypothesis of heredity

ERNEST WARREN

Natal Museum, Pietermaritzburg

Silicon Transformer Steel Residue

IN his book "Applied X Rays" Dr G L Clark publishes some very interesting photographs showing the connexion between the magnetic hysteresis loss and the grain size of 4 per cent silicon steels He takes the grain size to be inversely proportional to the number of spots produced under given conditions on a Laue photograph, and quotes a formula connecting this number with the magnetic hysteresis loss of the steel The fewer the Laue spots, the less is the hysteresis loss

Dr G Shearer, Mr C Wainwright, and myself some time ago obtained Laue photographs of samples of 4 per cent silicon transformer steels of different hysteresis loss which showed little difference in the number of diffraction spots, and what difference was to be observed tended to be contradictory to the above generalisation Further, no appreciable trace of orientation, which might have accounted for the anomaly, was found

Whilst the grain size must always be large for a steel of small hysteresis loss, it would appear that for closer comparison of magnetic value the straightforward interpretation of the Laue photographs can be misleading, and that other factors must be involved

Such a factor is suggested by the following preliminary account of an observation made in the course of a recent X ray study of steel residues, obtained by the method of Arnold and Read, in which the iron is removed by electrolytic dissolution The residues of six samples of silicon transformer steels, which, examined by the Clark method, gave anomalous indications of hysteresis loss, were investigated Three of these steels were good in that their hysteresis losses, measured at a maximum flux density of 10,000 lines per sq cm were only 1 19, 1 16, and 1 19 watts per kilogram respectively The other three were relatively bad with hysteresis losses of 1 78, 1 90, and 2 28 watts per kilogram respectively It was found that the residues of the bad steels gave a spectrum which was purely that of cementite, Fe_3C On the other hand, two of the good steel residues were amorphous, showing no diffraction pattern whatsoever, and the third gave only a few weak lines of some substance which was not cementite

It is suggested, then, that a difference like this will correspond to a difference in the value of the steel I have already shown that the state of subdivision of the carbide residues of steels is generally the same as the state of subdivision of the carbides when in the steel itself, so that the differences in aggregation of the particles observed by means of the X ray photographs of the silicon steel residues will correspond to similar differences among the carbides whilst in the steel It is hoped soon to pursue the matter further

W A WOOD

Physics Department,
National Physical Laboratory,
Teddington, May 29

Transmission of Potato Leaf-Roll

IN the course of experiments on potato leaf roll in progress at this College, proof has been found that *Myzus circumflexus* (Buckton) is an efficient transmitter of this disease There is also some evidence that another aphis, *Macrosiphum gei* (Koch), can transmit leaf roll feebly, but a definite opinion must await the completion of notes on the appearance of the progeny of infested plants

Myzus circumflexus, with us, has proved to be almost as reliable a transmitter as *Myzus persicæ* (Sulz), but there is a curious lag in the development of symptoms when the former aphis is used, so that plants infected with leaf roll by means of *M circumflexus* will still be in the 'primary' stage when those infected by *M persicæ* show rolling in lower as well as upper leaves Apart from the difference in the rate at which symptoms develop in infected plants, there is little to choose between the two species in their efficiency as transmitters

The discovery is of interest in several directions It corrects the growing tendency amongst plant virus workers to regard the relation of *M persicæ* to leaf-roll transmission as specific and unique At the same time, the difference in the response of a plant according to the species of aphis by which the inoculum is carried will tend to concentrate attention on the precise rôle played by the insect in virus transmission. I have been unable to find any record of the occurrence of *M circumflexus* on field potatoes in this country, so that, even if it does occasionally visit the

potato crop it is unlikely to be of much importance as a field transmitter of virus diseases in most seasons and most localities On the other hand, it has been recorded on *Hordeum*, *Avena*, and *Trifolium pratense* under field conditions, and this fact should be taken into account by workers who are attempting to maintain healthy stocks of potatoes in the field by isolating them in cereal crops or by intervening meadow land Theobald found it in great abundance out of doors in May, and quotes Laing as saying that the species breeds quite readily outdoor in mid summer Under glass house conditions it feeds voraciously on potato—whether sprouts, stem or leaves, and, with us, it has proved more prolific than either *M persicæ* or *Macrosiphum gei* on potato

Those facts and the ease with which the apterous viviparous female can be distinguished from other potato feeding aphides make it a valuable species with which to work on virus transmission Most of my work with aphis vectors has been carried out during the winter and spring months, and it is conceivable that summer generations of some species of aphides might vary in the efficiency with which they will transmit virus diseases May not this be a partial explanation of the negative results recorded by some workers when using species other than *M persicæ* ?

T WHITEHEAD

University College of North Wales,
Bangor, June 16

A Relation between the Continuous and the Many-Lined Spectra of Hydrogen

RECENT investigations on the continuous and the many lined spectra of hydrogen seem to show that there is some relation between the origin of the continuous spectrum and the electronic states of the term systems of the spectra of the hydrogen molecule We have often observed in our experiments that although the intensity of the continuous spectrum seems quite independent of the intensity of the atomic lines, certain band groups of the many-lined spectrum in the whole region of the visible are often strong when the continuous spectrum is intense In an ordinary discharge tube, for example, this continuous spectrum is produced with strong intensity at high pressure (5 8 cm of mercury), and is accompanied by the band groups of the triplet system of the hydrogen molecule in greater intensity than the other many lined spectrum According to our observations, most of them are classified as the transitions $2\,{}^3\Sigma - 3\,{}^3\Pi$, (Fulcher bands) and $2\,{}^3\Sigma - 4\,{}^3\Pi$

According to the interpretation of J G Winans and R C G Stueckelberg (*Proc Nat Acad Sci*, **14**, 867, 1928), this continuous spectrum originates in the transition from any one of the excited triplet levels to the unquantised ground state ($1\,{}^3\Sigma$) of this system Thus the above experimental fact suggests one relation between the continuous spectrum and the many lined spectrum of hydrogen and seems to favour the view of Winans and Stueckelberg After further experiments the results will be published elsewhere in detail

Y HUKUMOTO

The Physical Institute,
Imperial University, Sendai,
Japan, May 3

Siliceous Shells of Protozoa

IT is of course well known that some Protozoa (as Radiolaria and Heliozoa) have the hard parts siliceous, while others (as Foraminifera) have them calcareous Sponges show analogous groups In 1911,[1] when discussing the freshwater genus *Quadrulella* (Rhizopoda), I remarked · " In his recently published (1911) paper on the Rhizopods of the British Antarctic Expedition, Penard calls attention to the curious fact that while the square plates of *Q symmetrica* are siliceous, those of *Q irregularis* (Archer) are calcareous, and will dissolve in hot concentrated sulphuric acid He therefore inclines to agree with Awerinzew that the two animals are really generically distinct, and represent a case of convergent evolution " There has just been published a very interesting paper by Heron Allen and Earland [2] in which they describe a new genus (*Miliammina*) of Foraminifera with a siliceous test, represented by five species in the Antarctic But, in 1914, Chapman dealt with one of these species, calling it a new variety *arenacea* of the northern *Miliolina oblonga* (Montagu) The new form is said to be a siliceous 'isomorph' of the porcellanous *M oblonga* The question naturally arises whether in such cases we do have 'convergent evolution', as I postulated in 1911, or divergent evolution, the form of the shell being ancestral the material of it changed Heron Allen and Earland are a little ambiguous about the type species of their new genus I now formally designate as such *Miliammina arenacea* (Chapman), which they, for no apparent reason call *M oblonga* (Chapman)

T D A COCKERELL

University of Colorado
Boulder Colorado, May 17

[1] *University of Colorado* **8**, No 4 p 240
[2] *Jour Royal Microscopical Society* March 1930, p 38 *et seq*

Slug or Horned Viper ?

THE earliest example of the animal which is shown in Prof T D A Cockerell's letter in NATURE of May 17 proves that it is a snake and not a slug

FIG 1

The chronological evidence is of importance, for Prof Cockerell's example dates only to about 1400 B C, while the ivory carving is predynastic, that is, before 3000 B C

M A MURRAY

University College
Gower Street London, W C 1

The Diffraction of X-rays by Vitreous Solids and its Bearing on their Constitution.

I WAS interested to see the statement, by Messrs J T Randall, H P Rooksby, and B S Cooper on the above subject in NATURE of May 22, p 458, that silica glass corresponds to either cristobalite or tridymite crystallites of average size $1\ 5 - 2\ 0 \times 10^{-7}$ cm This confirms the theory of the formation of glass I published in the *Transactions of the Society of Glass Technology* in 1919 (vol 3, p 282) I pointed out then that glass is not a super cooled liquid, such as phenol, which becomes solid on the addition of a small crystal of that substance, but is a solid colloid consisting of amicroscopic crystals, the formation of which is due to the high viscosity and degree of aggregation of the components in the fused state

S C BRADFORD

The Science Museum,
South Kensington,
London, S W 7, May 15

The 1851 Exhibition Commissioners and their Work *

THE SIXTIES SEVENTIES AND EIGHTIES

IN the sixties seventies and eighties the Commissioners were occupied in promoting the usefulness of the Main Square of the ground they had reserved for purposes concerned with science and art Some of these may be noted as representing the breadth of view with which they regarded the trust committed to them

The Exhibition of 1862 proposed and carried through by the Royal Society of Arts occupied part of that southern section of the ground which was bought in 1867 by the Government and on which the Natural History Museum was built for the Trustees of the British Museum To the north of that area the central portion of the ground was let to the Horticultural Society for a period of years After that Society s occupation the galleries which the Commissioners had erected along the east and west sides were leased to the Government that in the east in 1879 for the India Museum—and that on the west in 1882 for the Science Collections From 1862 to 1871 the Commissioners co operated with the public in providing a representative memorial to the Prince Consort in a Hall forming a central point of union where men of Science and Art could meet —the Albert Hall The Hall did not in fact establish itself to this effect What we see to day in part—and soon shall see in still larger part—is rather the fulfilment of the wish expressed at the time by Her Majesty Queen Victoria *That the establishments then already placed upon the Estate as well as those that might be expected to come there should be considered as a whole forming the most lasting and worthy memorial of the Prince s untiring and unselfish exertions for the general good*

In the period during which the Commissioners had unoccupied ground within their Main Square they afforded facilities for many temporary measures for extending knowledge and for cultivating a desire for it To cite a series of international exhibitions there were 1883 The Fisheries Exhibition 1884 the Health Exhibition 1885 the Inventions Exhibition which included the permanent Science Collections mentioned above 1886 The Colonial and Indian Exhibition which included the permanent India Collections

Of loan collections the most pregnant was the 1876 Loan Collection of Scientific Instruments and Apparatus which was opened by Queen Victoria In 1882 they leased the Western Galleries to the Government for the Science Collections consisting at first mainly of objects placed in that Loan Collection and either given for the permanent collection or left as long term loans This collection was reinforced in 1883 by the addition of the Patent Museum collections The combination thus effected formed the nucleus of the Science Museum of to day

In 1879 the Commissioners had leased the Eastern Galleries to the Government for the India Collections

* Continued from p 932.

In this period the Commissioners had granted long leases at nominal rents for institutions that they considered pertinent to their aims To mention some of these 1872 The Albert Hall 1879 The City and Guilds Institute 1882 The Royal College of Music The Imperial Institute opened by H M Queen Victoria in 1893 In 1876 they had offered to the Government to provide a site and £100 000 towards the cost of buildings connected with science and arts and in particular for a Museum of Science This offer was declined in 1879 In 1888 they submitted a further offer in this sense and they pointed out that progressive appropriations of sites on their estate increased the urgency of the Science Museum question In 1890 the Government accepted this offer

TAKING STOCK AS AT THE END OF THE EIGHTIES

Let us take stock—moral and material—as at 1889 To the credit side we must place not merely the great achievements which are indicated in the foregoing paragraphs but also—what the Commissioners themselves had kept constantly in view—the influence these had had at long or short intervals upon the development of public opinion and of official activity The record of early results of this influence need not be detailed it springs to the mind as one thinks of the several points of departure From the remarkable intellectual and industrial success of the great adventure for which the original members of the Commission were recruited Britain at home and abroad reaped a wonderful widening of vision as to its own powers and possibilities together with a keen realisation of the activities and methods of its foreign neighbours From the material success of the Exhibition the Commissioners garnered *money* which they devoted to the promotion of aims in direct furtherance of the aims of the Exhibition itself They found themselves as it were in a position with a wide outlook over a half developed area They determined to stabilise their position so that it could be held and used as a centre of influence for generations to come They watched for good openings in the wide stretch of the interests of science the arts and the industries Their material resources were but trifling in proportion to the possibilities of their indirect action They could do effective work only by pointing to fertile areas for public activity by illustrating methods of improvement and by tempting the strong to put their backs into the work They themselves could to some extent explore but only in a very small way could they act as pioneers They could point to illustrations of fertility which their exploration had disclosed or their pioneer work had proved They must leave to others its development

In their Sixth Report (1878) the Commissioners recall that their surplus (1852) was £186 000 and they show that between 1852 and 1878 they had contributed to public purposes sites buildings etc to the value of nearly half a million They state

that the land in their possession or soon to fall in, would, if cleared, possess a market value as building land exceeding a million sterling At the same time, however, they had considerable liabilities To buy out the interest of the Government in the land purchased jointly, the Commissioners had to supplement their available funds by borrowing, in 1859, £120 000 at 4 per cent, then in 1860 they borrowed £50,000 in connexion with the development of the "Main Square" This debt was reduced or increased at intervals as the development of the estate proceeded and as the financial results of their temporary activities varied In 1878 it was £155,000, in 1889, £134,000 (By 1891 it was reduced to £24,000)

AIMS CARRIED FORWARD FROM THE 'EIGHTIES TO THE 'NINETIES

Some items in the earlier records of the Commissioners bear directly on their activities in their second forty years Thus, in June 1876, they received a memorial from the president and fellows of the Royal Society urging the establishment of a Museum of Science The Commissioners themselves had submitted to the Treasury in the same month an offer of substantial co operation in this project, but no effective progress ensued As mentioned above, this offer had been declined in 1879

Next the Commissioners were assailed by the cry 'Divide'—divide the possessions committed to their trust In July 1877 they received a deputation of municipal representatives from provincial boroughs in England and Wales urging the realisation of the funds of the Commission to as great an extent as possible and the distribution of the proceeds of this realisation in grants to provincial museums Mr Joseph Chamberlain introduced the deputation and the Prince of Wales (afterwards King Edward), chairman of the Commission, asked Lord Granville to reply It was a reasoned reply—*in the negative* Towards the end of that reply it was stated that the Commissioners aimed rather at establishing scholarships (This interesting, and critical, interview is reported in detail in Appendix 'S' of the Commissioners' Sixth Report, 1878, and the subject is fully discussed in that Report)

The establishment of scholarships then forecast was held over until the Commissioners could make a sufficient reduction in their mortgage debt to set free an adequate surplus of income In 1889 they reported that they were in a position to allot for scholarships an annual sum "not less than £5000"

1891–1930

Science Research Scholarships—The Commissioners established their scheme of science scholarships in 1891 It had been prepared with great care, and it soon proved itself well and wisely conceived This scheme has been outlined in the opening section of these notes

In certain other fields the Commissioners have endeavoured, by such schemes as they could afford, to meet particular difficulties of the time They thus initiated

Industrial Bursaries in 1911, to enable well qualified university students of limited means to enter employment in industries which, at the outset, would entail costs greater than their means could meet The Commissioners award these bursaries by selection based on the reports of the university or college authorities as to the qualifications of the men they recommend

Post-Graduate Naval Architecture Scholarship in 1911, similarly awarded on the recommendation of the Institution of Naval Architects

Art Scholarships, 1912—the Rome Scholarships—administered by the British School at Rome, These are awarded by competition in London, and are tenable for three years in the School at Rome Three are offered at each annual competition, each scholarship is of value £250 per annum, and is tenable for three years at the School at Rome To provide suitable conditions in Rome for the studies and practice of their scholars, the Commissioners have co operated with others in the provision and maintenance of the British School at Rome

Throughout this period, successive developments in science, art, and industries led to expansion of the field, intermediate between education and practice, in which the Commissioners found it to be their opportunity, and indeed their duty, for the time being, to supplement other restricted resources or facilities available To day, four fifths of their ordinary income, which is limited, is devoted to such purposes

A 'LOCALITY' AND ITS BUILDINGS

Yes, Locality again Their own baby born nearly eighty years ago—"Vision" his father his mother 'Surplus' His foster parents—as usual in these days—an incorporated body, would fain see him functioning to the full of his inherited ability The public he was born to serve, proved tardy in recognising his inherent powers to serve them Generations of trustees have tended, watched, and worked for his development For this they required understanding and help alike from the State and from the public In the opening years of the present century these came in with good effect To day the omens are good, and it is not too much to look for great progress in the course of the 'thirties

DEVELOPMENT AFTER 1890

In 1891 the Commissioners had sold to the Government—at much less than its value, but "for purposes of Science and Art"—a key section of their "Main Square" The opening century found this eligible site in much the same condition as did 1891, but soon the Government had put in hand a building to accommodate the Physics and Chemistry Departments of the Royal College of Science, the Science Library, and two galleries for the Science Museum In 1905 the Government appointed a Committee—with an experienced and energetic member of the Royal Commission as its first Chairman—to consider the Royal College of Science and Royal School of Mines, present and future, as to staff, buildings, and equipment

The outcome of this—made possible by liberal support from generous donors and from private funds for buildings and from the Commissioners as to sites—was the Imperial College of Science and Technology The new College was constituted by incorporating in this single institution the Royal College of Science, the Royal School of Mines, both Government institutions, and the Central Technical College The last named had been established by the City and Guilds of London H M King Edward VII laid its foundation stone in 1909

The terms of the charter of the Imperial College showed that it was conceived as an institution with such freedom of action as would enable it to react quickly to developments of outlook, alike in science, in industry, and in methods of training The Commissioners welcomed the new college as one that would be in a strong position to promote the organisation of advanced education and research in science as applied to industry, and they devoted to its use the unoccupied sites on the south side of Prince Consort Road This allocation of sites did not interfere with any institution already on the area

BUILDINGS

The erection of the first block of the new building for the Science Museum was in progress in 1914, but was then interrupted It was resumed after the War, and the new building was opened by H M King George V in 1928

Operations have now begun for the erection of the new Museum of Practical Geology and headquarters of the Geological Survey This building will be contiguous to that of the Museum of Natural History and to that of the Science Museum Its completion will bring the Geological Survey and Museum close to the Royal School of Mines, which was first opened under its wing in Jermyn Street in 1851

On the Prince Consort Road section of the "Main Square" there now stands—at the east end, the Goldsmiths' Company's extension of the City and Guilds' Engineering College, and, continuous with that, the block devoted to geology and specialised sections of the Royal School of Mines This combined block of buildings was opened by H R H the Duke of York in 1926 Then to the west—beyond the Royal College of Music—there now stands the first part of the Chemical Technology Department of the Imperial College On the north side of the road, and facing this last, is the Students' Union and the Botany Department of the College On the southern transverse road of the "Main Square"—Imperial Institute Road—the central feature of the north side is the Imperial Institute itself The eastern part of that building is occupied by the headquarters services of the University of London Facing this, on the south side of the road, is that block of the Imperial College which houses the Physical and Chemical Departments and, in the centre, the Science Library, in connection with the Science Museum

The central part of the northern portion of the "Main Square" is largely occupied by buildings of a temporary nature, but the main lines of utilisation, as a whole, are now determined by the permanent buildings in being or in course of erection

The Victoria and Albert Museum, the Natural History Museum, the central block of the Imperial College, the first section of the new Science Museum, were all built by the Government on land bought, on favourable terms, from the Commissioners The new Geological Museum is in course of erection on the same section of the ground

It ought to be noted that the methods of construction used in the buildings of recent years make it relatively easy to transform interiors so as to meet changes of requirements as times change

SUMMARY

Let there be no misunderstanding While every forward step referred to in these notes has had a definite relation to the aims the Commissioners maintained through the decades, their expenditure in promoting the realisation of these aims has been but trifling in proportion to the costs of converting aims into practice Their influence has been essentially in the direction of initiation, of nursing, of demonstration on a small scale, and of affording to others an opportunity of trying out this or that idea For causes in which they firmly believed, they have not failed to continue their assistance through many years when other support failed to materialise Again, when a scheme seemed to have done all it could at the time, they discontinued demonstration and waited and watched

Their primary and their large aim was the development of 'system'—'system' in the sense in which they used the word *after* their first Report—the sense in which it is used in these notes The development and natural application of 'system' in this sense has been carried on and is being carried on by the *State*—not by the Commissioners In all major causes none but the State *could* carry it out

The speech from the Throne at the opening of Parliament, 1852–53, contained the following passage

"The advancement of the Fine Arts and of Practical Science will be readily recognised by you as worthy of the attention of a great and enlightened nation I have directed that a comprehensive scheme shall be laid before you, having in view the promotion of these objects, towards which I invite your aid and co-operation"

Following on this, the question of extending "a system of encouragement to local institutions for Practical Science" was taken up by the Government The Department of Science and Art was established in 1853 and the administration of Schools of Design, which had been established previously, was transferred from the Board of Trade to that Department Under the Department of Science and Art and, from 1903, under the Board of Education, which absorbed it and could administer its services on a broader basis and with a greater measure of central and local assistance, art, science, and technology became essential elements in national administration Government departments and local authorities, the University

Grants Committee, and the Universities have co operated in promoting a full development of 'system' From time to time the Commissioners have provided aids for able students at critical points, and they have already found it possible to move upward one of their scaling ladders

The Royal Commission has been, in its years, prospector, promoter, patron—patron in the cen turies old sense of extending wise guidance and limited assistance to persons or projects that appeared capable of furthering science or the arts, or of stimulating inventions or industries In the nature of things the ideas of the Commissioners have occasionally been too much in advance of the time to secure effective response Yet, when prospects improved and the idea still seemed good, it was tabled again with any modification that seemed desirable

It has been so with the realisation of all that was implied in their aim—a Locality—the establishment of varied central institutions in the area pegged out nearly eighty years ago The realisation of this part of their aim has been slow, and time has altered the conditions—alike as to pur poses and as to methods The substantial ele ments are taking shape, but it is fully realised that they must retain elasticity

F G OGILVIE

Progressive Agriculture

AN unusual and interesting example of successful co operation between industry and agricul ture is portrayed in the jubilee volume issued to commemorate fifty years' work of the Blanchisserie et Teinturerie de Thaon,* in the Vosges After the annexation of Alsace and Lorraine, France found herself bereft of several of her most im portant bleaching establishments, and in 1872 a society was formed to establish the industry at Thaon in the Vosges, M Armand Lederlin being installed as the first director The difficulties to be overcome were great, as the selection of the site had to be largely determined by the presence of abundant water free from chalk and iron, so essen tial for bleaching purposes This was the first industry to be established in a purely agricultural area, and, from the beginning, it has also been the centre of agricultural demonstrations seeking to aid the peasants and workmen to get the best results from their land The success of the venture was primarily due to M Armand Lederlin, an impassioned agriculturist and a great industrial worker, whose work was carried on by his son, M Paul Lederlin, who succeeded him as director in 1909 Their endeavours have raised the status of a little country village, numbering only 555 inhabitants in 1870, to an important township of 8000 people, prosperous in industry and also in agriculture

After 1903 many other allied establishments were acquired, until at the present time about ten thousand workpeople are employed, dealing with some two million metres of material per day of eight hours The Thaon Blanchisserie is probably the most powerful firm in Europe for the treatment of textiles Throughout its history a very close association has been maintained between the heads of the firm and local social and municipal life Housing problems, questions of public hygiene, the moral and intellectual development of the personnel, libraries, insurance, and organisations to reduce the cost of living, represent but a few of the activities which are supported and encouraged by the Blanchisserie

* Hoffmann, P, et Deboffe, J (1930?) Cinquante ans de travaux sur l agriculture et sur l'horticulture, 1877-1927 (Paris J B Baillière et Fils)

Before the foundation of the firm, the chief industries of the district were cattle raising and potato growing, a little oats and rye also being cultivated M A Lederlin was inspired by the work of the Rothamsted and Woburn Experi mental Stations in England, and of M George Ville in France, to strive to introduce the new ideas of the utilisation of chemical fertilisers for the improvement of crops, with the view of in creasing the prosperity of the district His aims and interests were primarily local, being intended to determine what varieties of agricultural plants were most suited to the district, but the results ultimately attained wider significance as the scope of the experiments extended The jubilee report recently issued is intended to prevent the results of the earlier experimental work from falling into oblivion, and generous support from the Blanchisserie has facilitated the reproduction of many tables and photographs

From 1879 until 1919 continuous agricultural experiments, carefully laid out, were carried on by M Armand Lederlin, and when he gave up the work by reason of age his son proceeded to carry on another series of somewhat different scope The aim is still to be useful to the Department of the Vosges, and the produce of the plots is sold to the personnel at prices often below the cost of production The chief immediate aim is now to improve cattle and crops by numerous experiments on selection and acclimatisation In connexion with the experimental farm, potatoes are the most important crop, for they are well suited to the soil and are also the source of the starch of which so much is used in the industry, the whole production of 2000 tons of potato starch per annum being absorbed by Thaon and its daughter establishments

Unsuccessful attempts have been made to establish another potato, *Solanum commersoni*, which provides edible aerial parts suitable for cattle food, and comes up year after year without replanting, from portions of the root left in the soil There is also a model dairy farm, with land specially cultivated for cattle food, a horticultural society with a very high standard of production, nurseries for raising conifers and deciduous trees for street

planting, and apiaries to encourage local beekeeping, while laboratories have been equipped to deal with the various chemical and biological problems associated with plant growth

The latter part of the report gives a detailed account of the results of the experiments An interesting feature is the agronomic soil map of Thaon, showing the areas lacking in certain essential plant nutrients, with some land containing too much nitrogen In this connexion is given a detailed table of the necessary manuring for various crops in different parts of the Thaon area Thirty-seven per cent of the whole area is in woods and forests, the rest being chiefly potatoes, with some wheat, oats, beetroot, and carrots The experiments on these crops embrace tests on variety, adaptation and acclimatisation, transmission of disease by seed, problems of selection and the degeneration of species, as well as the effect of manurial treatments In the latter connexion the action of disinfectants and accessory elements, such as sulphur and manganese, is receiving attention

The problem of weed eradication has been dealt with experimentally in this district, as charlock is a very serious menace to the crops Many sprays have been tried out, the results varying as usual with the weather, but excellent results and increased crops are claimed from the use of sulphuric acid, as much as thirty five per cent increase over the control being obtained Special systems of crop rotation are also suggested to mitigate the pest

The value of the agricultural section of the report would have been much enhanced if the conclusions from the many years' experiments had been collected and summarised, as it is generally necessary to go laboriously through the work of several years to gain information on any special point of interest Apart from this, the authors are to be congratulated on the production of a volume setting forth so clearly the working out of a sociological problem which offered special and unusual difficulties that have been successfully overcome by MM Armand and Paul Lederlin, with the co-operation of their staff W E B

Obituary

PROF G N STEWART

NEWS has been cabled from Cleveland, Ohio, of the death of George Neil Stewart, the well known physiologist Born in 1860 in London, Ontario, whither his parents had temporarily migrated from Lybster, Caithness, Stewart, while yet a child, was brought back to Great Britain He entered the University of Edinburgh in 1879 and graduated M A four years later with honours in mathematics, having meanwhile acted as assistant to Tait, the professor of physics During the session 1883–84 he was Mackay Smith Scholar and in 1887 received the degree of D Sc But physics did not hold Stewart for long He turned his attention to medicine and graduated M D in 1891, receiving a gold medal for his thesis Then followed a year's post graduate study in Berlin, after which Stewart was appointed senior demonstrator of physiology at Victoria College, Manchester In 1889 he became George Henry Lewes student in physiology at Cambridge, a position which he held until 1893, meanwhile acting as examiner in physiology in the University of Aberdeen and taking the then recently established Diploma in Public Health of Cambridge Several months during 1892 were also spent in the physiological laboratory in Strasbourg

Migrating in 1893 to the United States, Stewart spent some months as a voluntary research worker with Prof Bowditch at Harvard University, who then nominated him for the chair of physiology at the Medical School of the Western Reserve University, Cleveland, Ohio, which was one of the first of the medical schools west of the Alleghany mountains to abandon the proprietory system, establishing in its place a full-time staff in the laboratory subjects During the next nine years, Stewart found in Cleveland every opportunity to develop his subject both in teaching and research, the first evidence of his success being the publication in 1895 of "A Manual of Physiology with Practical Exercises" It can truthfully be said that his admirable book marked an epoch in the teaching of physiology, for it succeeded in showing how formal exposition could be interwoven with practical work The student of medicine under Stewart learned his physiology by doing experiments which were carefully chosen and planned so as to form the basis for the more or less informal lectures which were grouped around them Many of the practical courses in experimental physiology in the American schools are patterned on those outlined in Stewart's book, which passed through eight editions, of which the last appeared in 1918 It was largely through Stewart's influence that Western Reserve Medical School was among the first to follow the example of Johns Hopkins in raising its entrance requirements to three years in an academic college, thus making a combined arts and medicine course of seven years' duration This scheme in a somewhat modified form has since been adopted by the majority of medical schools in America

In 1903, Stewart was called to the University of Chicago to succeed Jacques Loeb in the chair of physiology, but here he stayed for only four years, being enticed back to Cleveland to organise and direct the department of experimental medicine which was established in memory of H K Cushing, whose son, Harvey Cushing, is the well-known professor of surgery in Harvard In this position Stewart found full scope for his untiring and painstaking research work in various fields of experimental medicine, the results of which have appeared from time to time in numerous papers, published mainly in the *American Journal of Physiology*, the *Journal of Pharmacology and Experimental Therapeutics*, and the *Journal of Experimental Medicine* These papers along with those of his associates have been issued in eight volumes (1911–1926) of

"Collected Papers from the H K Cushing Laboratory for Experimental Medicine, Western Reserve University" In 1920, Stewart was honoured by receiving the LL D of his Alma Mater

It would occupy too much space to give here an account of the many problems to the solution of which Stewart and his pupils have made valuable contributions His earliest work, influenced by his training in physics, concerned the electro physiology of nerve and the application of Talbot's law Then followed researches on the nerves of the heart and the circulation time, the latter being really pioneer work Attracted by the development of knowledge concerning the physical chemistry of solutions, Stewart then conducted numerous investigations bearing on the mechanism of the action of hæmolytic and agglutinative agents and the problem of permeability of animal cells The results of these researches were published in a monograph in 1909 ('The Mechanism of Hæmolysis with Special Reference to the Relations of Electrolytes to Cells")

Desiring to contribute to clinical medicine something which might be of assistance in the precise diagnosis of circulatory disturbances, Stewart elaborated (between 1910 and 1915) an ingenious calorimetric method for measurement of the rate of blood flow through the hands and feet, and with this he made numerous observations on hospital patients About 1918 were started researches on the functions of the adrenal glands, which occupied his attention until his death

Stewart was induced to enter this field because of the extravagant claims which were then being made concerning the relationship of the internal secretion of the adrenals to arteriosclerosis, diabetes, and various other diseases and conditions of the body With great experimental ingenuity and meticulous care, Stewart, with the assistance of Rogoff, proceeded to investigate the conditions in animals under which increased secretion of epinephrine occurs This work led him to conclude that epinephrine does not represent an internal secretion in the ordinary sense, but is rather of the nature of a metabolic by product, and that variations in its secretion into the blood are not of the physiological significance which others have assigned to them He denied, for example, that conditions of emotion, fright and fear in animals, are associated with significant variations in the internal secretion of this substance As the work proceeded, it became more and more evident that it is the cortex rather than the medulla of the adrenal gland that is of real physiological significance Whereas all of the medullary tissue could be destroyed without significantly affecting the well being or the behaviour of the animal, destruction of the cortex as well led ultimately to death, although not until after a much longer period than had hitherto been supposed Convinced that the cortex must produce an internal secretion which is essential to life, its deficiency being the cause of the symptom-complex known as Addison's disease, Stewart during the past few years sought for methods by which extracts could be prepared that would prolong the lives of adrenalectomised animals and prove of value in the treatment of adrenal disease in man

By those who knew him intimately, Stewart was greatly admired both as a scientific worker and as a man of broad sympathies and deep culture His quick wit, his remarkable memory, and his eloquence made him a most interesting lecturer and a notable figure in society meetings Although domiciled for more than thirty five years in the United States, he remained a British citizen, and during the earlier years of the War spent several months in England and in France seeking for an opportunity to do service for the allies

Stewart leaves behind him a widow and four children, who may rest assured that their grief is shared by the many who were fortunate enough to have him for a friend J J R MACLEOD

MR A F R WOLLASTON

ALEXANDER FREDERICK RICHMOND WOLLASTON, who died in his rooms at King's College, Cambridge, on June 4, shot by one of his pupils in a moment of insanity, was the son of George Hyde Wollaston, for many years a master at Clifton College He came of distinguished parentage Through his mother he had kinship as grandson and nephew with the artists George and W B Richmond from her he inherited a love of good music and painting and literature, and unerring taste On his father's side, the name and family has been famous for two centuries and more, as the 'Dictionary of National Biography" shows Chief in the list there given are the brothers Francis and William Hyde Wollaston, the former was his direct ancestor

Wollaston was born in 1875, and went from Clifton to Cambridge and the London Hospital, where he qualified in 1903 Many friendships were formed in his university days, among them one which decided the course of his life Alfred Newton, professor of zoology, Wollaston's senior by some forty five years, recognised his exceptional gifts and encouraged him to become a naturalist explorer All the activities of his student years combined to fit him for this Besides his medical qualifications he had acquired experience as a traveller and mountaineer, and a wide range of knowledge of living creatures and plants As a field naturalist he was in the first rank, and he possessed a tall spare frame capable of great endurance

Wollaston's reputation among geographers and naturalists was established by the two expeditions, organised by the British Museum and the British Ornithologists' Union respectively, to Ruwenzori and to New Guinea, and by his delightfully written narratives of them [1] On Ruwenzori he twice climbed peaks (one of which now bears his name) which he supposed with good reason to be the highest of the range When the expedition came to an end, he and Carruthers made their way southward to Lake Tanganyika, thence westward to the upper waters of the Congo, and voyaged down the river to its mouth A curious common feature of

the two expeditions was the discovery in each of a race of pygmies The results of the New Guinea expedition were disappointing, through no fault of the explorers Wollaston returned there in 1912 with a party led by himself, the outbreak of the War frustrated his plans for a third expedition, and our hopes for a new book of travel from his pen His "Life of Alfred Newton", at which he had laboured for several years, could not be published until 1921, and was then reduced to half its intended size

For his work in the War—in the northern patrol, under Smuts in East Africa, on a monitor, and on the Murman Coast—Wollaston received the Distinguished Service Cross In 1920 King's College elected him a fellow, and for a time Cambridge was his home But two more journeys lay before him He went as medical officer and naturalist on the first Everest expedition, and in 1923 he married, and set out with his wife to an almost unknown mountain range in Colombia Quiet years followed He served on the council and later became honorary secretary of the Royal Geographical Society, he had been the recipient of the Society's Gill memorial medal and the Patron's gold medal in 1914 and 1925 At the time of his death he had been tutor of King's College, Cambridge, for eighteen months

It is difficult to imagine a man with greater power of inspiring affection and confidence than Wollaston, he was so completely honest, sensible, and straightforward His wanderings were over, they had brought him fame and honour, their dangers had passed by him unharmed Blessed in his home-life and with friends innumerable, all the signs foretold for him many years of peaceful happiness

H W R

[1] "From Ruwenzori to the Congo, a Naturalist's Journey across Africa and Pygmies and Papuans, the Stone Age to day in Dutch New Guinea It is not out of place here to refer to the admirable appreciation of Wollaston in Henry Newbolt's Book of the Long Trail

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WE regret to announce the following deaths

Prof W H Bristol, formerly professor of mathematics at the Stevens Institute of Technology, Hoboken, and inventor of numerous recording instruments for pressure temperature, and electricity, as well as of devices for sound amplifying, and talking motion picture apparatus, aged seventy years

Dr Allerton S Cushman, founder and director of the Institute of Industrial Research in Washington, and author of papers on corrosion and other chemical subjects, on May 1, aged sixty two years

Dr George Dimmock of Springfield, Mass known for his contributions to entomology, on May 17, aged seventy eight years

Dr J Arthur Harris head of the Department of Botany of the University of Minnesota, whose interests lay in ecology and biometry, on April 24, aged forty nine years

Dr Charles F McKenna, president in 1910 of the American Society of Chemical Engineers, on April 25, aged sixty eight years

Dr Thomas F McKinney, from 1908 until 1928 professor of mathematics in the University of South Dakota, known for work on continued fractions and the theory of equations, on April 14, aged sixty five years

News and Views

ON June 19, Dr and Mrs Robert Mond entertained a large number of distinguished guests at a dinner held at the Savoy in honour of Sir W M Flinders Petrie, who this season has completed his fiftieth year of exploration and research in Egyptian archæology Addresses and messages of congratulation and good will were received from the British Academy and other scientific and learned bodies It is no exaggeration to say, however, that outside the immediate circle present on this occasion, the whole world of those who are interested in humane studies now offers its tribute of veneration to a great scholar and research worker To the historian of the future, Sir Flinders Petrie will not merely rank with the one or two great and familiar names in Egyptology, he will stand out as the first to set the study of Egyptian archæology upon a scientific basis—one whose work has served not only as a model and guide for all subsequent research, but also has made ancient Egyptian culture live in the eyes of a modern generation The system of sequence dating which he elaborated as a classification and a means of assigning to their proper horizon the material objects of Egyptian culture from predynastic times to the close of its existence as a separate entity in the ancient world, equally with the order and method he exemplified in his own excavations and inculcated and demanded in the work of others, have laid archæological studies under a debt to him which it is difficult to estimate By maintaining steadfastly the point of view of the anthropologist he has kept Egyptology in relation with wider studies and saved it from the aridity of the specialist outlook with which it was threatened

IN 1875, as a young man of twenty two, Sir Flinders Petrie began the study of the ancient monuments of Britain, and by 1880 he had published his "Inductive Metrology" and "Stonehenge" From 1880 onward he visited Egypt annually, publishing the reports on his excavations with minutely conscientious documentation and after the minimum of delay consistent with careful preparation His discoveries range from predynastic graves to the Greek settlements of Naukratis and Daphnæ—Koptos, Naqada, Abydos Lahun, and many more, a lengthy list now landmarks in Egyptian archæology Egyptian literature, art, social life, technical methods and appliances, magic and religion, in fact all sides of Egyptian life and culture, have been reviewed by his pen, and finally the results of his work were gathered together in his monumental history of Egypt As workers in other fields well know, his interest in the problems of and methods of general archæology has been kept keenly alive Further, it is not only by his own researches that Sir Flinders Petrie has served archæology At home as Edwards professor of Egyptology at University College, London

—a post which he accepted in 1892—and in the field by practical instruction and supervision he influenced and moulded generations of research workers. In 1894 he founded the Egyptian Research Account, which became the British School of Archæology in Egypt in 1905. Through this organisation his excavations in Egypt continued until a few years ago, when local circumstances made it advisable that the field of operations should be removed to Palestine. In the organisation and administration of his research Sir Flinders has been loyally assisted since his marriage in 1897 by Lady Petrie. He received the honour of knighthood in 1923, and his work was further commemorated by the foundation of the Petrie gold medal, which is awarded for outstanding achievement in the study of general archæology.

IN the last issue of the *Royal Naval Engineering College Magazine* is a short account of the history of the College, which was first opened on July 1, 1880, fifty years ago, and in which to-day all midshipmen and sub-lieutenants for the engineering branch of the Royal Navy receive their training. For a long time the training of 'engineer boys' and 'engineer students' for the navy was much on the same lines as that of dockyard apprentices, but owing to the recommendations of the Cooper Key Committee of 1875, H.M.S. *Marlborough* was allocated for a training school at Portsmouth in 1878, and two years later Keyham College came into existence. For some time the two establishments ran side by side, but from 1888 onwards all engineering education has been carried out at Keyham. The valuable character of the training given in the *Marlborough* and at Keyham was fully demonstrated during the War, out of which the engineering branch came with a fine record. Nearly all the senior engineer officers in the fleet and at the Admiralty and dockyards had passed through one or the other, in which there has always been a sound combination of instruction in both theory and practice. With the reorganisation of naval education by Lord Selborne and Lord Fisher, entries to Keyham ceased in 1905, and since then the College has seen many changes. Eight years ago, however, all midshipmen for engineering duties were sent there, and to-day there are some 180 midshipmen and sub-lieutenants in residence. As in former days, the instruction is given partly by naval engineers and partly by civilian instructors, and to these have been added a number of naval instructors. The course extends over four years, and the College is fully maintaining and adding to the prestige it enjoyed under the old regime.

"L'AFFAIRE GLOZEL" slowly draws to an inevitable but undignified conclusion. By the irony of circumstance the solution is reached not by the reasoned arguments of the scientific archæologist, but by the empirical methods of the police bureau. The libel action brought by the Fradins, father and son, against those who had impugned the authenticity of the finds they had 'discovered' and exploited, it was obvious, would leave the main issue untouched, and might even have strengthened their position, already well established with the general public. It therefore seemed to the opponents of Glozel that the most effective counter was the institution of a criminal prosecution by the Société préhistorique de France on a charge of obtaining money from the public by exhibiting modern objects as antiques. The exhibits were seized by public authority and examined by M. Bayle of the Service d'Identité judiciaire. This officer found evidence of modern fabrication and affirmed *inter alia* that the bricks had not even been baked and contained substances of modern origin such as strands of cotton coloured by aniline dye, and pieces of moss and grass still retaining chlorophyll, etc. The assassination of M. Bayle has delayed the presentation of the report, which, however, is imminent and will, it is anticipated, be followed by the punishment of the culprit. The whole story is set forth with no little humour and some pungent comments on certain individuals in *Antiquity* for June by M. Vayson de Pradennes, whose intervention in the controversy in 1927, it will be remembered, was crucial. His article is an instructive document, not merely as a detailed survey of the course of events in the Glozel fraud, but in its bearing upon certain aspects of the forgery of antiquities in general.

ALTHOUGH the topical character of the article on Glozel and its bearing upon a sensational series of events gives this feature of the June number of *Antiquity* a special attraction at the moment, the remaining contributions do not fall below it in their level of interest. Prof. Eilert Ekwall writes on the early names of Britain with no suggestion, however, that as yet any name earlier than of Celtic origin is known. Mr. Estyn Evans carries further the investigation of the invasion of Britain at the later stage of the Bronze age by a wave of Celtic-speaking peoples, of which a suggestion was first put forward by Mr. Crawford. He here examines the origin and distribution of certain type specimens of late Bronze age cultures. Dr. Cecil Curwen follows up an earlier communication on prehistoric agriculture by a paper on flint sickles, in which he discusses the interesting problem of the polish on the cutting edge of the flint teeth. The earthworks on Butser Hill, near Petersfield in Hampshire, are discussed at some length with the assistance of air photographs by Mr. Stuart Piggott, who argues that the earliest settlement is to be dated at about 2000 B.C. "Notes and News", from various contributors, include a note by Mr. M. C. Burkitt on a polished stone axe associated with kitchen-midden material from South Africa. He points out that very few polished axes have been found in South Africa, and that this is the first time an association with a definite culture has been demonstrated. He also directs attention to the discovery by Prof. Drennan of a skull and femur of Australoid type in a sand quarry at Cape Flats, near Cape Town.

M. ALBERT THOMAS, in his report as Director of the International Labour Office, refers to the relations between the Soviet Union and the international institutions of the League of Nations. Before 1929 there appeared to be a possibility of definite collaboration in

scientific investigation, but in that year a decided change took place. An offensive against 'bourgeois science' has been developed in Russia, which has taken various forms. Scientific institutions have been reorganised on Marxian lines or have been abolished. Non-communist specialists and technicians have been deprived of their posts, and numerous congresses have been organised to frame new sciences based on Marxian principles. M. Thomas comments that collaboration has been rejected even in the scientific field between Soviet institutions and the international institutions of the 'bourgeois and capitalist' countries, because this would involve the separation of science from politics and a distinction between the examination of the actual situation and Marxian analysis.

AT the meeting of the Royal Statistical Society on June 17, the retiring president, Mr. A. W. Flux, delivered an address on a comparison between the food supply of the United Kingdom in the five years ending 1928 and in the five years ending 1913. For the earlier period, the results of the investigations of the Food (War) Committee of the Royal Society were available, and for purposes of comparison Mr. Flux applied a similar procedure to the five years ending 1928. The examination of the results of the two sets of data showed that no large change in the effective supply of food has occurred, having regard to the numbers for whose maintenance the supplies sufficed. The number of persons whose food supplies were the subject of the two inquiries was substantially the same at the two dates, but the different age constitution of these numerically equal populations renders the needs of the post-War population greater than those of the pre-War population. The 45¼ million of the pre-War population was computed to be the effective equivalent of 35 million adult men, while the equal post-War population was computed to be equivalent to 36 million adult men. The available supplies of food reduced to their energy equivalent gave 4000 calories per day per equivalent adult man. In the make-up of the food, fat had a somewhat larger importance in the later period than in the earlier, while proteins and carbohydrates had a somewhat smaller importance. Dairy produce and vegetables, and, still more, fruit, showed important increases, while meat and cereals both decreased, the latter in greater proportion than the former. In the later period the energy value of the food was derived in the proportion of forty per cent from home produce and sixty per cent from imported produce.

THE British Polar Exhibition will be open at the Central Hall, Westminster, from July 2 to July 15. The exhibition, which is under the patronage of H.R.H. the Prince of Wales, is designed to illustrate the achievements of British polar explorers, especially those of recent times. Numerous exhibits have been lent by museums, learned societies, and private collectors. Among expeditions that will be represented are those of *Erebus* and *Terror*, *Alert*, and *Discovery* to the north, and *Southern Cross*, *Discovery*, *Scotia*, *Nimrod*, and *Aurora* to the south. One section will be devoted to relics, ship models, flags, paintings, and photographs, another to modern work with apparatus and specimens, and a third will be occupied by firms supplying polar equipment. A lecture on north polar exploration will be given on July 2, and one on south polar exploration on July 10. The Scott film recently acquired for the nation has been lent by the trustees and will be shown most evenings and two afternoons. An authoritative polar handbook, with short articles on discovery, meteorology, geology, whaling, birds, diet, etc., and illustrated by maps, will be on sale. A number of recent books on polar work will also be on sale. The organisers are giving their services voluntarily. If, after costs are met, there is any surplus revenue, it will be given to institutes or societies engaged in geographical research.

THE report of about 150 newspaper representatives from various countries upon the sixth *Achema*, or Great International Exhibition of chemical apparatus, at Frankfurt-on-Main, indicates the striking progress which has been made in developing commercial international relationships since the first exhibition of its kind was held ten years ago in Hannover. The press delegates were addressed by Dr. Bretschneider, the organiser of the exhibition, who explained that the primary object of the *Achema* was to promote co-operation between chemists and engineers. The exhibitors this year include many foreign firms, and a prominent feature of this exhibition is the historical section, which includes a model of Liebig's laboratory at Giessen in 1842 and a selection of manuscripts and books. In one section many optical and electrical measuring instruments are displayed and automatic devices for the analysis of gases and liquids, balances designed to record the weight of a dust particle, ultra-microscopes for the detection of molecular movements, and X-ray apparatus for the resolution of crystal structure. An attempt is made to demonstrate in striking fashion the great economies which can be effected by the adoption of standard sizes for the component parts of chemical apparatus. Another section is devoted to the artificial silk industry, the various machines used in all stages of its manufacture being displayed. In the other sections may be seen acid-proof blowers of earthenware, condensing plant constructed of fused quartz, a material which until fairly recently was only used on the small scale, fire-proof building materials, rustless steel, and huge containers constructed of aluminium, nickel, and other metals. The press regards the exhibition as an event of outstanding international importance, since it brings out the vast significance of the present state of development of chemical industry, which plays a leading part in modern civilisation.

ALL workers in scientific and technical fields will welcome the new scheme initiated by the Council of the Association of Special Libraries and Information Bureaux (26 Bedford Square, W.C.1) to form a panel of expert translators. The scheme will be doubly welcome by reason of the undertaking that the members of the panel will consist only of individuals or associations who have satisfied the Council as to their abilities, not merely to translate literally, but also to

interpret the finer shades of differentiation in scientific and technical terminology The difficulty of obtaining such experts has long been recognised Faced by a sudden emergency necessitating expert translation, the would be employer has generally been compelled to rely on the commercial translating bureaux, which are rarely provided with quite the right type of expert required, or alternatively has placed the work in the hands of an individual qualified in the subject concerned but not up to the standard in the particular language involved It is scarcely conceivable, however, that exactly the right type for each particular problem does not exist, and the only requirement for bringing the work and the worker together would appear to be an organisation on the lines proposed by A S L I B This Association has done much towards rationalising the bibliographical realm, and this latest of its activities will meet an urgent and growing need

By the co-operation of the British Post Office Telephones, the Canadian Marconi Company, and the Bell Telephone Company of Canada, Sir Ernest Rutherford, speaking from his home in Cambridge, was able to address the meeting of the Royal Society of Canada in Moyse Hall, McGill University Montreal, on May 20 According to the *Montreal Gazette* for May 21, he congratulated the Society on the efficient manner in which it had encouraged the advance of learning in the Dominion since its foundation in 1882, and its president, Dr A S Eve, on his conspicuous services to McGill University for which Sir Ernest expressed his warm feeling The reception by loud speaker was extremely powerful, in the early stages somewhat blurred but quite clear later Sir Arthur Currie jokingly remarked to Sir Ernest that many of his old students present expected that his voice would be more mellowed by age and honours, while Sir Ernest repudiated Sir Arthur's suggestion that he had not replied to his last letter

During the present week, June 21-28, the North East Coast Institution of Engineers and Shipbuilders and the Institution of Engineers and Shipbuilders in Scotland have been holding their joint summer meeting in Holland, the programme including visits to some of the most important slipyards at Flushing, Amsterdam, and Rotterdam One of these is the Fijenoord Company, which has been in existence since 1823, and which recently completed the motor ship *Baloeran* of 16,000 tons, this being the largest passenger vessel ever built at Rotterdam Nearly as old as the Fijenoord Company is the Werkspoor Company of Amsterdam, a firm which in 1910 constructed the first reversible marine Diesel engine, and which up to the present time has constructed Werkspoor Diesel engines of a total of 365,400 I H P The firm has also recently supplied large screw pumps for the Medemblik and Den Oever pumping stations on the Zuyder Zee Reclamation Works These works, a visit to which was included in the programme, were described by Mr J W. Thierry in a paper to the British Association in 1928, and in *Engineering* for May 23 and June 30 and succeeding issues he is giving further particulars of these important undertakings, which will ultimately add more than half a million acres of land to Holland Among other places visited was the Nautical Technical Institution and Museum at Rotterdam, founded in 1916 by private subscription for furthering the interests of shipbuilding and nautical science, but which is open to the public

For the latter part of the meeting, the headquarters of the Institutions was at Scheveningen, a seaside town on the coast, off which took place the action between the English under Monk and the Dutch under Tromp when the latter was killed Here on June 25, two papers were read, one on the " Interior Architecture of Ships " by Prof P A Hillhouse and Mr A M Gardner, and the other on " Transportation of Oil by Sea ", by Mr J McGovern, the President elect of the North East Coast Institution The world production of petroleum, said Mr McGovern, had increased from 70,000 tons in 1860 to 213 million tons in 1929, while the present fleet of oil tankers had a carrying capacity of approximately ten million tons, the ships forming about 11 per cent of the total world tonnage Though oil at first was carried either in barrels or in wooden ships especially altered for the purpose, the prototype of the modern oil tanker was the *Gluckauf*, built by Messrs Armstrong in 1885. In this ship boiler riveting was adopted throughout But the general design of oil carrying vessels followed that of the ordinary cargo ship until Sir Joseph Isherwood introduced the longitudinal system of framing, which resulted in increased longitudinal strength with a reduction in the weight of material His patent was taken out in 1906, the *Paul Paix* was built on this system in 1908, and was the forerunner of the 943 oil tank vessels built or ordered according to the Isherwood plans In recent years, owing to the carriage of benzine, or oil containing sulphur or acids, corrosion has increased, and unless the metallurgist or chemist can produce more suitable steel or protective coating it would appear that the life of some tankers would be limited to ten or fifteen years

The annual report and accounts for 1929 of the Ross Institute and Hospital for Tropical Diseases, Putney Heath, London, S W 15, has been issued The work of the Institute is reviewed, including research work and malaria expeditions The total receipts from donations and subscriptions show an increase of £2500, and income over expenditure a surplus of £2467, but as the Institute has no endowment fund, the balance of £12,000 in hand must be regarded as a reserve against contingencies

A useful little catalogue (No 12) of second hand books of botanical interest, including some rare herbals, has been issued by Mr J H Knowles, 92 Solon Road, S W 2

Applications are invited for the following appointments, on or before the dates mentioned —A full time graduate science assistant master at the Hammersmith School of Building and Arts and Crafts—The Education Officer (T 1), County Hall, S E 1 (June 30). A senior mathematical master at Swin

don College—The Principal, The College, Swindon, Wilts (July 1) Assistant lecturers in chemistry, physics, botany, and pharmacy at Cardiff Technical College—The Principal, Technical College, Cardiff (July 2) An assistant for metalwork and mechanical drawing at Darlington Technical College—The Chief Education Officer, Education Office, Darlington (July 4) A lecturer in physics and electrical engineering at Handsworth Technical College—The Principal, Handsworth Technical College, Handsworth, Birmingham (July 4) Civilian education officers in the R A F educational service, one with a degree in engineering and one with a degree in history—The Secretary, Air Ministry, Gwydyr House, Whitehall, S W 1 (July 5) A full time teacher in engineering, a full-time teacher in physics, and a visiting teacher for engineering economics, at the West Ham Municipal College — The Principal, Municipal College, Romford Road, West Ham, E 15 (July 5) An honours graduate to teach pure and applied mathematics at Loughborough College—The Registrar, Loughborough College, Leicestershire (July 5) An assistant lecturer in education with special qualifications in the teaching of science subjects at the University College of the South west of England—The Registrar, University College, Exeter (July 7) A technical assistant to the adviser in agricultural economics at Armstrong College — The Registrar, Armstrong College, Newcastle upon Tyne (July 7) Geologists on the Geological Survey of Great Britain —The Director, Geological Survey and Museum, 28 Jermyn Street, S W 1 (July 9) An assistant lecturer in economics in the University of Birmingham—The Registrar, The University, Edgbaston, Birmingham (July 11) A lecturer of botany at the University College of Wales, Aberystwyth—The Financial Secretary, University College of Wales, Aberystwyth (July 14) A demonstrator in mathematics at the Royal College of Science, South Kensington—The Secretary, Imperial College of Science, South Kensington, S W 7 (July 14) An assistant lecturer in zoology in the University of Bristol—The Secretary, The University, Bristol (July 14) An additional lecturer in engineering at Chesterfield Technical College—The Principal, Chesterfield Technical College, Chesterfield (July 15) Two botanists for cacao research at the Imperial College of Tropical Agriculture, Trinidad—The Secretary, Imperial College of Tropical Agriculture, 14 Trinity Square, E C 3 (Aug 19) A professor of hygiene in the Egyptian University, Cairo, and a lecturer in dental surgery—The Dean of the Faculty of Medicine, Egyptian University, Cairo (Sept 20) A headmaster of Christ's Hospital, Horsham—The Clerk, Christ's Hospital, 26 Great Tower Street, E C 3 A whole time lecturer in geography at St Mary's College, Strawberry Hill—The Principal, St Mary's College, Strawberry Hill, Middlesex Instructors in electrical engineering, advanced building construction, and practical mathematics at the Kingston upon Thames Technical College and School of Art—The Principal, Technical College, Kingston upon Thames A full time assistant master for engineering at Erith Technical College — The Principal, Erith Technical College, Belvedere, Kent Inspectors for the purposes of the Diseases of Animals Act, 1894–1925, under the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S W 1 A professor of natural philosophy in the University of Aberdeen—The Secretary, The University, Aberdeen

Our Astronomical Column

Remarkable Meteors —Mr W F Denning writes that on June 9, at about $0^h\ 35^m$ A M G M T, a large fireball was seen from many places in the north of England It presented a white nucleus which looked nearly as large as the full moon and lit up the country About twelve observations have been received, from which it appears that the fireball was directed from the N N W sky and was probably at a height from 60 to 50 miles The radiant was not far from the horizon, but the data are somewhat conflicting and exact deductions are scarcely possible

Fireball of June 15 —At $23^h\ 12^m$ P M G M T a meteor equal Venus was observed by Mr Kingman at Bristol It passed from 261° + 21° to 305° + 59° and was directed from a radiant in Scorpio near 237° – 25°

An Early Perseid.—On June 15 at $23^h\ 22^m$ G M T a first magnitude meteor with the very swift motion and bright streak characteristic of the Perseids was well observed It shot from 359° + 75° to 142° + 74° and its direction conformed very nearly with the radiant point of the Perseids on the same night which is in the region dividing Pegasus and Lacerta at 342° + 3[illegible]

On June 16 at 1 30 A M G M T, when scarcely any stars were distinguishable in the misty sky, a fine meteor was noticed from Bristol as it ascended from the horizon in due west and sailing upwards disappeared when nearly reaching the zenith—velocity slow, duration 10 seconds

Further accounts of these curious objects will be valuable for computing the real paths

Occultations of Stars by the Moon —The April issue of the *Journal* of the Royal Astronomical Society of Canada contains an article on this subject by Prof E W Brown He notes that the campaign of observations of occultations which is now being vigorously carried on in many countries, dates from a paper by Dr R T A Innes (1923), in which he showed the value of such observations for determining the errors of the lunar tables Prof Brown considers that since the introduction of the new lunar tables in 1923, the chief residual errors in the moon's position are due to irregularities in the earth's rotation He gives two diagrams of the moon's residuals, one on a small scale from 1650 to 1930, the other on a larger scale from 1875 to 1928 In forming these he has omitted from his tabular places the "great empirical term" with period of about 2½ centuries, as he considers that the cause of this, as of the smaller fluctuations, lies in the earth's rotation, not in the moon A feature of the graphs is the abruptness of the sudden changes of direction The dates of the more marked changes are 1780, 1898, 1917 Prof Brown notes that these observations are eminently suited for amateurs A 3 inch telescope suffices, and a clock or watch sufficiently good to give to the nearest second the interval between a wireless time-signal and the phenomenon

Research Items

Harvard-Boston Expedition's Excavations in the Sudan—In *Sudan Notes and Records*, vol 12, pt 2, Dr G A Reisner reports on the excavations which were carried out in the seasons 1927–28 and 1928–29 at the forts at Semna and Uronarti as part of a larger plan to examine all the old forts extending from Semna to Halfa It is known that these forts of Semna and Uronarti were built before or during the twelfth dynasty, when trade, which in earlier times had suffered much from hostile tribes, had become organised and the country subdued by military expeditions The northern Sudan was then occupied by officials who were little more than trading agents, transport was maintained mainly by water, and protected by fortified posts along the river The desert tribes were a constant source of danger to the trading fleets The excavations have served to throw light on the methods of navigation of the cataract and how traffic was controlled by land and water The ramparts of the forts command a wide view, and signalling from fort to fort was possible They completely dominate both land and water routes Each was built on a hill and the plan was drawn to suit the configuration Inside the thick outer wall of crude brick ran a street and the space inside the street was divided into blocks by cross streets Each block was divided by walls into separate apartments, providing temples, dwellings for the commandant and officers, barracks for the men, storehouses, etc Judging from the quarters and the cemeteries, in which the burials include women and children as well as men, the garrisons must have been small, perhaps from 50 to 150 fighting strength The forts were all occupied in the New Kingdom, and later, many of the important objects discovered belonging to this period

Inheritance in Man—The Galton Lecture before the Eugenics Society is published in the *Eugenics Review* (vol 22, No 1) In it Prof S J Holmes discusses natural selection in man, and reaches the general conclusion that under modern conditions selection is more effective in eliminating the less endowed than is usually supposed He gives reasons for thinking that the intelligence quotient is, on the average, the most important single factor in survival, and that "the present economic order is much more deadly to people with dull minds" The death rate tends to be high in proportion as the occupation requires little intelligence or skill On the other hand, selection against many physical defects has been largely eliminated Racial differences in susceptibility to disease exist For example, negroes have a low death rate, as compared with whites, from scarlet fever, erysipelas, diphtheria, measles, and skin diseases, but a high mortality from tuberculosis, pneumonia, and other respiratory diseases From statistics of mortality rates, Prof Holmes reaches the conclusion that the male is inherently the weaker sex, although a part of the higher male infant mortality is due to recessive sex linked factors and a part to birth trauma He finds that the male death-rate during the first year is high owing to faults of organisation, and that the male death ratio from epidemic diseases is also high during this period

Measurement of Ultra-Violet Radiation—The simple method of measuring the biologically active ultra-violet rays of the sun introduced by A Webster and Leonard Hill, and now used at many meterological stations, consists in the fading of a standard solution of acetone and methylene blue in a quartz tube The degrees of fading are tested against a set of standard colour tubes, and each degree represents two to four times the dose of ultra-violet rays required to produce erythema of the white skin—two to four because skins vary in sensitivity The standard solution exposed to the sunlight in the presence of air fades somewhat in a tube of glass which excludes the biologically active ultra violet rays There is, however, very little fading when air is excluded, and any error due to fading by long waved ultra-violet and visible rays can be excluded by exposing a control sample of the standard solution in a glass tube, and deducting the degree of fading of that from the degree of fading in a quartz tube Dr M Bender, of the Institut fur Strahlonforschung, Berlin, informs us that he has introduced a variation of method, namely, exposing a solution of acetone and determining the action of the ultra violet rays on this by adding a standard solution of Fuchsin Schwehlige Säure and determining the depth of red violet tint produced He claims that this modification gives good agreement with cadmium cell determinations of the ultra violet rays A detailed account of his results will be published in *Strahlentherapie*

Life History of the Pismo Clam—Mr William C Herrington gives an interesting account of the bionomics of *Tivela stultorum* (Mawe) with special reference to its depletion ("The Pismo Clam, Further Studies of its Life History and Depletion" Division of Fish and Game of California *Fish Bulletin*, No 18 Contribution No 81 from the California State Fisheries Laboratory) This huge heavy shelled bivalve at eight years old may weigh from one to four pounds It is found in abundance on the open sandy beaches of California, but only where it is exposed to constant washing and pounding of the surf extending from the intertidal zone out into the surf for an unknown distance and in places forming a successful commercial fishing Prof F W Weymouth ("Tho Life History and Growth of the Pismo Clam", 1923, No 7 of this publication) has already described fully its habits and appearance The present paper is specially concerned with the extent and cause of depletion, effect of present protective methods, relation of dominant year classes to fluctuations in abundance, age at sexual maturity, relation between size and number of eggs, growth rate and deviation from the normal in the growth of individual year classes Spawning begins at the end of the second or third year The eggs are very small and the average number in specimens from seven to ten years old is 75,000,000 per clam, the smallest producing the fewest eggs The growth shows a distinct seasonal rhythm, rapid in summer and slow in winter The large clams have been steadily dwindling in numbers in spite of the bag limit and the size limit The growth rate does not appear to be affected by crowded conditions There are great fluctuations in abundance, due principally to dominant year classes and the effects of the fishing The greatest fall is in the tidal zone, especially in the Pismo Oceano Beach, where so many visitors dig for clams and are the probable cause of the scarcity Stricter protection of undersized clams is advised and regulations which will decrease the strain on the breeding stock, if the Pismo clam fishery is to be maintained

Chondrocranium of the Lizard—The morphology of the chondrocranium of *Lacerta agilis* is known to most students of zoölogy from the reconstructions of Gaupp of 31 mm and 47 mm stages De Beer (*Quart. Jour Micro Sci*, May 1930) has described

the detailed development of the chondrocranium from the first cartilage to appear, namely, Meckel's cartilage, up to nearly the younger of Gaupp's stages The employment of van Wihje's victoria blue staining technique enables the cartilage to be differentiated from the pro cartilage and so makes the identification of the former more accurate than was possible by older methods From his observations the author concludes that in all living reptiles, excluding Ophidia which are highly specialised, there is the same general form of a tropitrabic skull, with a trabecula communis, an interorbital septum, and a planum supreseptale, and in all the posterior portion of the orbital cartilage is more or less reduced *Lacerta* has certain affinities with such Chelonia as *Emys*, *Chrysemys*, and *Chelydra* In addition, the lacertilian chondrocranium has several points of similarity with that of *Sphenodon* and the crocodiles or, in other words, the Diapsida, which may be taken as suggesting that the Lacertilia have been derived from this group

Colour Change in Fishes —Mr Charles Haskins Townsend, director of the New York Aquarium, has published a very interesting booklet entitled "Records of Changes in Colour among Fishes" (New York Zoological Society, 1929) Besides copious notes made from the fishes in the aquarium, there are many beautiful illustrations, both photographs and coloured drawings The coloured plates are specially good, particularly those by Hashine Murayama, whose sketches are wonderfully alive The colour changes are usually instantaneous, as many as seven quite different guises being observed Some of the changes are due to uncomfortable surroundings or sickness, but most of them are adaptations to surroundings; sometimes a colour change may be attributed to anger or fear The author has in previous works emphasised the fact that one colour description or drawing is not sufficient to identify a fish The present work fully bears out this statement

Larvæ of the Coleoptera —In the *Bulletin of Entomological Research* for March 1930, pp 57 72, will be found a useful paper by Mr A W Rymer Roberts, consisting of a key to the larvæ of all the chief families of the Coleoptera It is now more than twenty six years since MacGillivray's paper on the same subject appeared and, in the interval, a large amount of exact knowledge of the larvæ of various genera and families has come to light The foremost modern worker in this field, Dr Adam G Böving, has published a large amount of high class research, and the results of his work, and those of other entomologists, have been freely drawn upon by Mr Roberts in order to make his paper as complete as possible It is obviously beyond achievement at present to provide a complete key of this kind because, in a few families, the larvæ are still unknown or too poorly described for inclusion These necessary omissions, however, are so few that their effect on the value of Mr Roberts's paper is almost negligible Users of his tables will find the terminology adopted relatively simple, and there is, further more, an illustrated glossary of the terms employed At the end of the paper the reader will find a guide to the more important literature on the subject up to and including the year 1929 The general classification followed is that used by Reitter in the "Fauna Germanica", which is a readily accessible work

Microscopic Examination of Coal —Under this title Mr Clarence A Seyler gives a very clear, straightforward account of methods of preparing microscopic sections of coal or of preparing polished, etched surfaces for examination in reflected light It is published as No 16 of the Physical and Chemical Survey of the National Coal Resources, by the Fuel Research Division of the Department of Scientific and Industrial Research (London H M S O) Mr Seyler states that the tissues which are met with still in a more or less intact form in coal are either secondary xylem or periderm, usually fibrous tissue with the cells considerably elongated in the axial direction Usually the pieces lie in the coal in a horizontal direction, so that the plant axis lies parallel to the bedding plane. A full description is given of the methods by which the investigator can elucidate the plant structure by sections in directions transverse, radial longitudinal, and tangential longitudinal to the plant axis No other method of preparation of material for microscopic examination is dealt with other than that of sections Possibly, the new methods, using collodion or gelatine films, are not readily applicable to this material, but it would seem probable, especially where plant spores are the main recognisable material in the coal, that maceration methods would give results of value

Chromosomes of *Prunus* —In the genus *Prunus* the *n* number of chromosomes is 8 Dr Darlington (*Jour of Genetics*, vol 22, No 1) has made a further study of the cytology of this genus, in which he finds that the various forms of plums and damsons examined were all hexaploid In meiosis they usually form bivalent chromosomes, but occasional quadrivalents occur The wild *P spinosa* is tetraploid and also forms occasional quadrivalents It was found that in the hybrids of *P domestica* ($6n$), *P cerasifera* ($2n$), *P triflora* ($2n$), *P persica* ($2n$), and *P Amygdalus* ($2n$), there is perfect chromosome pairing in meiosis, which is taken to indicate that the chromosomes in the haploid sets of these species are homologous each to each *P domestica* × *cerasifera* produces a tetraploid form which behaves like a true species, all the chromosomes pairing, but certain of the pairs also uniting to form quadrivalents Various abnormalities of meiosis in these hybrids are also described, and classified under four heads, including omission of one or both meiotic divisions, the division of binucleate pollen mother cells, and the double division of the chromosomes when they have failed to pair From such conditions, *P avium nana* having 24 chromosomes in its sporophyte may produce gametophytic nuclei with 96 chromosomes It is pointed out that from the pairing of chromosomes conclusions regarding their relationship cannot always be drawn, and a relation between pairing and chiasma formation is suggested

Terrestrial Magnetic Surveys —The "Results of the Magnetic Observations made by the Ordnance Survey in England and Wales in 1928" (London H M S O, 1s net) gives complete data for *D* (declination), *I* (inclination), and *H* (horizontal force) for 30 stations, reduced to the epoch 1929 5, six of these stations were repeat stations, and for these the secular variation is given Preliminary declination results are given also for seventeen stations observed in 1929, fifteen being in the Scottish Lowlands, and two in the magnetically disturbed region near Melton Mowbray, three of the seventeen are repeat stations The instruments used for *D* and *H* are a coil magnetometer designed by Dr F E Smith, for *I* a dip circle is still used The Swedish Hydrographic Service have issued a *Magnetic General Chart of Sweden*, 1930 (Jordmagnetiska Publ Nr 7, Stockholm), giving, on three separate maps, isomagnetic lines for *D*, *I*, and *H* The observations on which the maps are mainly based were made with a Carnegie Institution pattern of combined magnetometer and earth inductor, the field work being done in 1928 and 1929, the stations chosen are to be repeat stations, at each

of them, the local variation of vertical intensity is tested by a variometer of the Ad Schmidt pattern

Physics in Fuel Research—In November last, Dr C H Lander, Director of Fuel Research, addressed the Institute of Physics on "Physics in Relation to the Utilisation of Fuel" and this lecture has just been published by the Institute Perusal of the reprint confirms the view that one can scarcely take a step in this, as in any industry, without involving some physical principle or process They are here indicated at all stages from the mine to the chimney stack To cite a modern example, it has been found that X rays prove useful in investigating and controlling the cleaning of coal, while X ray spectrometry is assisting in distinguishing the different forms of carbon in coke, which influence its reactivity All processes of coal cleaning utilise differences in the physical properties of coal and dirt The utilisation of fuel is obviously 'applied heat' The combustion of solid fuel is essentially a problem of air supply, and especially with pulverised fuels it is a question of controlling the relative motion of a gas over a solid Heat transfer involves the laws of radiation, conduction, and convection The conditions in practice are usually baffling in complexity, but the application of physical methods of study is carrying us further than the empirical methods of the past

Band Spectrum of Chlorine—An investigation of the absorption bands of chlorine, described by A Elliott in the June issue of the *Proceedings of the Royal Society*, is of interest in connexion with the nuclear properties of this element Four bands assigned to the molecule $Cl^{35}Cl^{35}$, and two assigned to $Cl^{37}Cl^{35}$ have been analysed, and it has been found, by means of intensity measurements, that the nuclear spin of the atom Cl^{35} is 5/2 quantum units, and that the lighter molecule is about 1 45 times as abundant as the heavier The latter number is decidedly less than the value 1 67 calculated from the direct measurements of the isotope ratio made by Dr F W Aston, but whilst the discrepancy is possibly due to errors in the spectroscopic work, it is apparently not quite certain that it is not real, and due to a greater absorption per molecule by the system $Cl^{37}Cl^{35}$ than by $Cl^{35}Cl^{35}$

Failure of Insulators due to Deposition of Sea Salt—A new instrument called a 'klydonograph', which has been much used in the United States for the recording of lightning flashes and atmospheric phenomena, has been found specially useful in connexion with overhead electric lines It is very important to know the causes of the sudden surges of electricity which cause breakdowns in high pressure electric supply systems The principle of the instrument is based primarily on the phenomenon known as Lichtenberg's figures Under electric stress, particles of certain kinds of powder, particularly sulphur, arrange themselves in a definite manner in the electric field Later on, it was discovered that the emulsion of a photographic plate was affected in a similar way by electric stress A voltage of 2000 across the electrodes is sufficient to give a record and by having a moving film a continuous record can be obtained In a paper read by S W Melsom, A N Arman, and W Bibby to the Institution of Electrical Engineers on April 10, interesting surge investigations on a 33 kilovolt line in South Wales which supplied a number of collieries and villages were made They traced breakdowns to a salt deposit which occurred on the insulators of the line following dry south westerly winds. The line was about twenty miles from the coast With a dry wind the salt spray is taken up, dried in the air and carried for considerable distances as a fine powder The salt powder impinges on the insulators and, helped by the electric stress, adheres firmly to them So long as the dry wind continues there is little danger of a flash over, but when the humidity of the air becomes normal the insulator gets covered with brine, which is a good electric conductor and leads to dangerous surges on the mains It was instructive to find that the greater part of the surging occurred on that one of the three phase conductors which was nearest the sea

Electric Currents to the Ground—A fresh estimate of the relative importance of the various agencies concerned in the transport of electricity between the ground and the air has been made by Dr T W Wormell in the June number of the *Proceedings of the Royal Society* (pp 585 589) The agents considered were four, the normal fine weather current and precipitation, which cause on the whole a downward movement of positive electricity, and lightning discharges and currents from points, the effect of which is in the opposite sense The numbers given for the charges brought to the ground by these in a year (with special reference to conditions near the Solar Physics Observatory at Cambridge) are respectively +60, +20, −20, and −100 coulombs per square kilometre These values are necessarily only approximate, but it seems very probable that the current carried by lightning and the point discharges together exceeds considerably the current carried down by rain, which is in the opposite direction, so that there is effectively a vertical upward current through a cumulo nimbus cloud from the earth to the upper atmosphere Dr Wormell refers to two other investigations which confirm this result, and remarks that they are in entire agreement with the theory of Prof C T R Wilson that the fine weather current into the ground over the whole earth is balanced by the currents maintained between the earth and the upper atmosphere by shower clouds

Recombination of Atomic Hydrogen—A preliminary report of some remarkable results obtained in connexion with the recombination of hydrogen atoms to form molecules has been published by F J Havlíček in *Die Naturwissenschaften* for May 30 The reaction was studied in gas at atmospheric pressure, and it was found that the concentration of atomic hydrogen fell off exponentially with time The time taken for the concentration to fall to a definite fraction of its initial value being thus independent of the initial concentration, it was concluded that the reaction was *mono molecular*, a result checked by the law governing the dependence of the decay constant upon temperature in the range between about 50° C and 500° C Details of the experiments are not given, but must be awaited with the greatest interest, as it is somewhat difficult to reconcile these facts, if substantiated, with the ordinary ideas of recombination taking place as the direct result of collisions

Analysis of Silicates—We have received from the Society of Glass Technology, Darnall Road, Sheffield, a copy of a brochure entitled "The Analysis of Glasses, Refractory Materials, and Silicate Slags" just published by the Society It contains eight papers or abstracts, some having been read to the Society during 1927 and 1928, with the discussions, and in one case the paper has been modified in the light of later investigations There is also an index The details given are sufficient for the guidance of any competent chemist, and the critical comments provide a review of the limitations and difficulties of the methods described The book, which is edited by Prof. W E S Turner, is a useful contribution to the analytical chemistry of silicates

Physics and Chemistry in the "Encyclopædia Britannica".

PHYSICS

THE editors claim that the physics programme is one of the most comprehensive and authoritative of the different divisions of the "Encyclopædia Britannica" Anyone wishing to use the work in the study of this branch of knowledge, after reading the article "Science", which surveys the whole world of scientific achievement, would be well advised to refer to "Physics, Articles on", for the main subdivisions and separate headings Sir Oliver Lodge, in the main article "Physics", discusses the history and development of the science which, by its derivation, means a study of Nature so far as it can be reduced by calculation and experiment to a few simple, or at least fundamental, laws It was hoped at one time that the mechanical laws of Galileo and Newton would be all inclusive Efforts to apply them not only to matter but also to the ether, and even to life and mind, and thus to find a basis for a materialistic philosophy, have proved unsuccessful So long as we are dealing with massive bodies or with great groups of particles, the Newtonian laws of dynamics are sufficient, and they reigned supreme till very near the end of the nineteenth century Modern physics may perhaps be said to date from 1895, the year of Röntgen's discovery of X rays This discovery not only provided the physicist with a new tool, it illustrated the idea put forward by Lorentz and Zeeman, and also by Larmor, that electric charges were the agents responsible for the generation of radiation

Prof Millikan, who writes on the "Electron" with authority, insists that one of the most important generalisations of all time is that of the electrical constitution of matter, for this conception underlies practically the whole of twentieth century physics The growth of this idea was gradual, and illustrates the fact that, for the most part, the progress of science takes place by a process of infinitesimal accretion In 1891, Johnston Stoney introduced the word 'electron' to designate a definite elementary quantity of electricity demanded by Faraday's laws of electrolysis—"Finally nature presents us with a single definite quantity of electricity which is independent of the particular bodies acted on" Stoney implies that every atom must contain at least two electrons, one positive and one negative, because otherwise it would be impossible for the atom as a whole to be electrically neutral In 1897, J J Thomson showed that the mass of the particles constituting the cathode rays was of the order of a thousandth of the mass of the hydrogen atom Later experiments have shown that the positive electron, while it has a charge of equal amount but opposite sign to the negative, is always associated with a *mass* about 1845 times greater "The positive electron is sometimes called the proton, and the word electron, when used without any qualifying adjective is usually understood to refer to the negative electron, but it is important to remember that historically, derivatively, and logically the word *electron* means, as indicated above, the unit *charge*, and carries no implication as to mass"

The oil drop experiments of Millikan prove that all electrical charges are built up out of a definite number of discrete elements or particles all exactly alike, the value of the electron charge being $e = 4\ 774 \times 10^{-10}$ absolute electrostatic units (the value quoted as "the latest determination" in the article "Physical Units" is quite out of date)

The dissection of the atom into electric charges is discussed by Prof Niels Bohr ("Atom"), who gives an account of his own most important theoretical work on the building up of groups of electrons round a massive positive nucleus to form a neutral and stable system He adds an interesting account of recent progress, dealing with the remarkable developments since 1925 associated with the exact quantitative treatment of the new quantum methods A more detailed account of the "Quantum Theory" is given by Prof W Wilson, who contributes an article of exceptional lucidity His description of the new wave mechanics and matrix mechanics is one of the best summaries with which we are acquainted

The third great advance of the present century, supplementing and consolidating the electron theory and the quantum theory, is the theory of "Relativity" This is treated in his usual able manner by Sir James Jeans, who also writes on the "Kinetic Theory of Matter" The general nature of the principle of relativity is first described "Just as Tycho's eight minutes of arc, in the hands of Kepler and Newton, revolutionised medieval conceptions of the mechanism of the universe, so Leverrier's 43 seconds of arc, in the hands of Einstein, has revolutionised our nineteenth-century conceptions, not only of purely astronomical mechanism, but also of the nature of time and space and of the fundamental ideas of science The history of this revolution is in effect the history of the theory of relativity It falls naturally into three chapters, a first narrating the building of the earlier physical theory of relativity, a second dealing with the extension of that theory to gravitation, and a third, which is still in process of being written, attempting to include electro magnetism in the physical system presented by the existing theory of relativity"

Mr Bertrand Russell discusses the philosophical consequences of relativity, and Prof Einstein gives an important if somewhat difficult account of "Space time", which is followed by a short description by Prof Eddington of recent attempts to absorb the electro magnetic field, and so provide a single background to all material activity—one unified field

A few of the more interesting articles on physics may here be mentioned Prof Andrade, who is the associate editor for physics, contributes articles on the atomic "Nucleus", on "Radiation", "Rays", on "Vacuum" and on "Transmutation of the Elements" Sir Ernest Rutherford writes on "Radioactivity", Sir Joseph Thomson on "Electricity, Conduction of", and on "Electric Waves" Dr Aston is specially qualified to discuss "Positive Rays" and "Isotopes", and Prof A Fowler to write the article on "Spectroscopy" The nature of "X rays" is discussed at length by M de Broglie, and X ray spectroscopy by Prof Manne Siegbahn, both of whom describe work with which they are themselves identified The standard articles on the branches of the older physics are assigned to the late Prof Callendar ("Heat"), Prof C G Darwin ("Light"), Dr A. B Wood ("Sound"), Prof H. A Wilson ("Electricity"), Dr E C Stoner ("Magnetism") Among the articles on the technical applications of physics may be cited an interesting account of the applications of "X rays" by Dr E V Pullin, "Wireless Telegraphy" by Prof Appleton and Dr Eccles, and "Photography" by Mr George Eastman and Dr C. E K Mees

The article on the "Wilson Cloud Chamber" deserves special mention, if only on the ground of the excellent reproductions of photographs of cloud tracks obtained by means of this apparatus. The paths of swift electrified particles are thus rendered visible, and it is possible to study the tracks of α and β particles and of electrons released by the

action of X-rays Of striking value are the photographs showing the expulsion of a proton by the impact of an α particle (Meitner), and the forked tracks showing nuclear collision of an α particle in oxygen and in helium (Blackett)

Science knows no national boundaries, but the policy adopted by the editors of asking foreigners to contribute articles on their own special subject suffers from several disadvantages, even when the author is recognised as one of the most distinguished specialists When reading such an article, it is evident that the writer is often translating his thoughts from his own language into English, so that the mode of construction is essentially foreign, and in some cases the word chosen to represent a technical term is not that best suited for the purpose The latter difficulty might perhaps have been avoided by more careful editorial supervision One could, however, go further and say that it is not merely the difference in language which creates an obstacle, there may also be a difference in the very mode of thinking which raises a barrier between author and reader In an original and independent contribution to science or learning, this is serious enough, but in an encyclopædia it is more than a drawback, it is almost a disqualification

We must not end, however, on a critical note Considered as a whole, these contributions to the study of experimental and mathematical physics reach a very high level, and are bound to have an important influence in the dissemination of accurate knowledge and in stimulating further scientific research

H S A

CHEMISTRY

It will be within the recollection of many of those for whose education encyclopædias are published, that Kai Lung's remote ancestor spent his entire life in crystallising all his knowledge and experience into a few written lines, which as a result became correspondingly precious The sentence "defined in a very original and profound manner several undisputable principles, and was so engagingly subtle in its manner of expression that the most superficial person was irresistibly thrown into a deep inward contemplation upon reading it" What an attractive encyclopædia the old gentleman and his co compressionists could have produced! How immeasurably greater would his achievement have been if his sentence could have changed its shades of meaning and enlarged its philosophical perspective with advancing thought and maturing experience! That, in effect, is what a maker of encyclopædias is called upon to do In a few short years the cut of the garments of a science such as chemistry appears impossible and even unhealthy, and the fabric itself gets moth eaten in places, some of the embroidery, too, now appears superfluous New discoveries are to be recorded, the ensemble has to be viewed afresh, new hopes arise while the epitaph is being written on the old

Presumably the editors of the "Encyclopædia Britannica"—the encyclopædia of the English speaking peoples, as it has been more exactly described —found it possible to revise a proportion of the chemical articles which appeared in the last edition, but it is evident that most of the matter has been entirely re-written Let it be said immediately that by undertaking the onerous and responsible duties of chemical editor, Prof G T Morgan has earned the thanks as well as the congratulations of both the scientific and the general public, so far as the chemical articles are concerned, the selection of the authors, all eminent exponents of their subjects, leaves nothing to be desired. The encyclopædia is not intended to be either a text book for students of chemistry or a reference book for chemists, nevertheless, the authors of the articles on chemical themes are just those to whose views and to whose exposition of them chemists themselves would most willingly pay attention In nearly every case (one cannot truthfully omit the "nearly") they have steered a middle course and appealed to the hypothetical intelligent layman who, with the man in the street and the average man, having been so long and so often the butt of our shafts of learning and wit, must surely now be possessed of a knowledge so encyclopædic as to render him independent of encyclopædias As a working hypothesis it is reasonable to assume that the most renowned specialist is in the view of another and different kind of specialist, just that ignorant but interested reader whose comprehension he must not underrate and whose curiosity he is anxious to arouse Whether such an assumption were made or not, in the result we have that combination of clarity, brevity, and solidity that appeals to the scientific worker

In such a collection of miniature monographs one does not expect uniformity Indeed, chemistry itself is far from uniform in methods in development, in language from exponents of different phases of the science, therefore, similarity of approach, unanimity of appeal, and equality in the assumption of premises are not to be anticipated As the same chemist is not usually deeply interested in both solutions and synthetic dyes, or in both gunpowder and glucosides, so the subject itself is too wide to admit of homogeneity in its revelation to the general public Hence it would not be fair to say that the article on "Thermochemistry" (Mr H T Tizard), for example, is less popular than that on "Valency" (Dr N V Sidgwick), because the former makes sparing use of mathematics, or that "Dyes" is more technical than "Catalysis", because it incorporates a large number of hexagons In point of fact, "Catalysis" (Dr E K Rideal) is a good example of an authoritative article which appears to have been written for the 'brethren', and "Synthetic Dyes" (Mr A G Green) of a highly technical subject treated in such a manner as to make the non chemical reader feel that he has missed his true vocation "Flame" (Prof A Smithells) is accompanied by photographs of types of flame structure, it is restricted to stationary flames Among other articles which deserve to be mentioned in any description of the chemical service of the encyclopædia are such, for example, as Prof G T Morgan's "Diazo Compounds" and "Organo Metallic Compounds", Mr J A V Butler's "Solutions"—pleasant as well as instructive reading—Prof W N Haworth's "Carbohydrates", Dr W H Mills' "Stereochemistry" (a lucid exposition of a difficult subject), Dr T A Henry's "Glucosides" and "Alkaloids", Prof R Robinson's "Chlorophyll", Dr A D Mitchell's "Ammonia", and Dr S E Sheppard's "Photochemistry" One finds notable revisions, such as "Argon" by the late and the present Lord Rayleigh, and "Atomic Weights" by the late Prof T W Richards

A comprehensive general review of the science of chemistry is offered in an article extending over nearly sixty pages and contributed by Prof H B Dixon ("History of Chemistry"), Dr J D Main Smith ("Inorganic Chemistry"), Dr E Holmes ("Organic Chemistry Historical"), Prof F Francis ("Organic Chemistry Aliphatic Division), Prof J. Read ("Organic Chemistry Homocyclic Division"), Mr R H F Manske ("Organic Chemistry, Heterocyclic Division), Prof H M. Dawson ("Physical Chemistry"), Mr B. A Ellis ("Analytical Chemistry

Inorganic)", Dr M A Whiteley ("Ultimate Organic Analysis"), and Mr E W Yeoman ("Gas Analysis") It is a substantial article, and a substantial contribution to the literature of chemistry In a work of such magnitude as the "Encyclopædia", the definition of boundaries must have presented considerable difficulties in seeking to provide for a thorough survey of the borderland between one science and another those regions lying between chemistry and engineering, or between chemistry and economics, for example, have acquired an importance second to none in the industrial outlook, both of the English speaking and of other peoples Due regard has been had to such common issues, but only a careful and exhaustive analysis of the treatment of cognate subjects shared both with other sciences and with other human interests would show whether the impression that little of first importance has been overlooked is accurate Ions, although discussed incidentally, have (except in regard to their catalytic action) scarcely been accorded their usual place of honour in chemical theory, whilst noticeable, this is doubtlessly completely devoid of significance

Allusion to the relation of chemistry to other human interests invites reference to the article entitled "Chemical Warfare", by Brig Gen Sir H B Hartley and Mr C G Douglas, where developments resulting from the use of gas as a military weapon by the German Army are described, together with measures adopted for protection against its effects In view of its efficacy as an arm in the field, the probability of its proving equally potent when used in conjunction with aircraft against industrial centres or even against the civilian population, and the ease with which chemical industry organised for essential national requirements in times of peace can be converted into an arsenal in time of war, the possibility of the future use of military gases in spite of international agreements is one which, we are warned, is felt not to be remote Until the danger is effectively removed by statesmen, it will remain all too obvious to chemists A A E

The Climate of the Pleistocene Period *

THE glaciation of northern Europe during the great Ice Age was due to a shift of the pole associated with appreciable variations of solar radiation

The shift of the pole brought Europe into sufficiently high latitudes to permit of the formation of an ice sheet, but the large variations of climate during the Ice Age, as shown by the interglacial periods, were due to the oscillations of the solar energy

If two complete cycles of solar radiation occurred during the Pleistocene period, it is possible to account for four advances of the ice in the Alps as demonstrated by Penck and Bruckner but the interglacial periods were not all warm The Gunz Mindel and the Riss Würm interglacial periods occurred at the maximum of the solar radiation and were, therefore, warm interglacial periods, but the Mindel Riss interglacial period occurred at a minimum of solar radiation and was, therefore, a cold interglacial period

At a maximum of solar radiation, that is during a warm interglacial period, the climate of north west Europe was warm and very wet with a relatively small annual variation of temperature As the intensity of solar radiation decreased, the mean temperature fell and the annual variation of temperature increased At the same time the amount of precipitation decreased The fall of temperature occurred sufficiently rapidly compared with the decrease in precipitation to cause the glaciers of the Alps to advance and for an ice sheet to form over Scandinavia As the solar radiation still further decreased the lack of precipitation caused the glaciers of the Alps to retreat At the minimum of solar radiation, there was a cold interglacial period with low mean temperature a large annual variation of temperature and very low precipitation In fact, a truly continental climate

With these changes of climate went a corresponding change in the flora, the sequence being park land, forest, tundra grass with sparse trees, and steppe In this way it has been found possible to determine a sequence of climates and of fauna and flora for the whole Pleistocene period which is supported by the geological and archæological evidence available In particular it is possible to arrange the sequence of human culture, the geological strata of East Anglia, and the history of the ice in the Alps into the scheme of climate change

The two maxima of solar radiation were accompanied by increased precipitation in all parts of the world, so accounting for the two pluvial periods which are known to have occurred during the Pleistocene period

* Summary of an address delivered before the Royal Society of Edinburgh on June 16 by Dr G C Simpson, F R S

The Mechanism of Variation [1]

By Prof Henry H Dixon, F R S

THE fundamental work on the production of variants by means of X rays and the γ radiation of radio active substances, which has been chiefly carried out during the last two or three years in America, is of profound interest to all students of biology By these means H J Muller found it possible to increase 150 times the minute amount of natural variation which is only accessible to estimation by laborious searching through tens of thousands of individuals It was observed that these variations were completely fortuitous, occurring in any characteristic, in any direction, some quite new, some known as occurring under natural conditions, some losses, some gains, but numerically proportional to the duration of radiation, or to the amount of air ionisation produced by the radiation used

Variations produced by this method are transmitted in breeding experiments to the offspring according to the known laws of heredity, so that there is no doubt that they are represented in the germ plasm by factors or genes They have been transmitted unaltered through fifty generations Changes in the chromosomes, corresponding to observed disturbances in linkage, show that the radiation alters the characteristics through alterations in the architecture of the germ-plasm Breeding experiments emphasise the random nature of the changes, since it has been shown that one gene, of two lying side by side in a chromosome, may be changed, while its *vis à vis*, not the thousandth of a millimetre distant, has remained unaltered The same gene in adjacent cells may also escape modification

This random, but minutely selective, action is just what might be expected to result from disturbances in the germ plasm due to the expulsions of electrons by the short waves of X rays, γ rays, and cosmic rays The great preponderance of lethal variations observed over viable and useful ones is only to be expected when we reflect on the necessary bewildering complexity of structure of the genes and the randomness of the dislocations produced by the radiations

Short waved radiation (X , γ , and cosmic radiation) is then a *vera causa* of variation, and just as in the experiments of Muller Stadler, Goodspeed Olson, etc , all manner of variations are produced and even the same variations repeated, so in nature the similar, but less intense, radiation is responsible at relatively long intervals for similar variations

With the aid of this fundamental new knowledge we have a ready explanation of many of the old standing difficulties in the path of the evolutionist The occurrence of similar morphological features in divergent lines of descent has produced much discussion and has been variously explained as due to homoplasy or innate tendencies, etc According to this new departure radiation acting on the germ plasm is responsible The architecture of the germ plasm of the divergent lines of descent is fundamentally similar Radiation causes all manner of fortuitous variations mostly lethal, and a limited number viable Hence in the lapse of time some of those which are viable and possibly advantageous recur in the diverging lines In the same way many atavisms and instances of parallel development may be explained

The possession of common morphological characters by the individuals of certain groups otherwise considered to be genetically far apart, has led to the self contradictory conception of polyphyletic groups and genera Viewed in the light of this new principle, however, such resemblances are due to nothing else but the reappearance of the same variation conditioned by changes in the genes by the short waved radiations of Nature Inasmuch as the majority of these variations are lethal the number of the viable ones are limited and must recur repeatedly as the phylogeny is extended

Again, instances of discontinuous distribution must often find their explanation in this recurrence of the same variation in different localities

In quite a different domain of evolutionary study this principle may be called in to supply an explanation of the relatively high number of endemics which are said to occur on high mountains Naturally, since variation is proportional to radiation, locations on mountain tops being screened from cosmic radiations by a shallower atmosphere should exhibit a greater number of variations than similar areas on the plains

It has often been pointed out that the uselessness of the intermediate stages in the development of a useful organ constitutes a serious difficulty in the theory of evolution based on the natural selection of accumulating minute variations But the conception of variation arising from within due to intra molecular changes in the germ plasm removes this difficulty It is quite conceivable that a gene, if only it retains viability, will be so altered as to condition the production of a useful character or organ without any intermediate steps being necessary

[1] Last spring when the work of Goodspeed and Olson called my attention to the causation of variation by X rays, I suggested (NATURE, June 29, 1929, p 981) that cosmic radiation is a factor in the production of variation by direct action on the germ plasm At the time I did not know that this suggestion had been made and had been experimentally substantiated by the brilliant work of the American investigators whose results are summarised in this communication —H H D

University and Educational Intelligence

BELFAST — Mr J G Semple, lecturer in pure mathematics at the University of Edinburgh, has been appointed professor of mathematics

CAMBRIDGE The following reappointments are notified Mr L E S Eastham Trinity Hall as university lecturer in advanced and economic entomology Dr T M Harris Christ's as demonstrator in botany , Mr H L H H Green Sidney, as demonstrator in anatomy , Dr S M Manton Girton as demonstrator in comparative anatomy

The vice chancellor announces that the Quick professorship of biology will become vacant next November when the period of three years for which Dr Nuttall was last elected will have ended A meeting for the election of a Quick professor will be held on July 16

The vice chancellor also gives notice that the Downing professorship of medicine is vacant by the death of Dr Bradbury

The Woodwardian professorship of geology will become vacant in October by the resignation of Dr Marr

At Trinity Hall, Mr C Forster Cooper having resigned the office of bursar has been elected to a non-stipendiary fellowship and Dr O H Wansborough-Jones has been elected to a research fellowship

LEEDS —The foundation stone of the new library building presented to the University by Lord Brotherton of Wakefield was laid by the donor on June 24 The Duke of Devonshire, Chancellor of the University, presided, and the meeting was addressed by him and by the vice chancellor the librarian and Lord Brotherton The vice chancellor remarked that Through the munificence of the Lord Brotherton of Wakefield this University will in a short time be in the possession of a library building worthy of the highest aspirations of its scholars its scientists, and its students, adequate to meet the requirements of the complete development of the University in the future unsurpassed if not unrivalled by any similar institution in this country ' A striking innovation is the fact that it will be possible to place a quarter of a million volumes on shelves that are open to the access of all readers A generous donor has given to the University a fine collection of Icelandic books which will find their place on the shelves of the new library building Lord Brotherton announced that it is his intention to house his own collection in the new library, to be held by the University in perpetual trust for the nation It is his desire that access to the books shall be accorded to all properly accredited persons With this end in view, Lord Brotherton is taking the necessary steps to endow the collection

LONDON —The following doctorates have been conferred *D Sc in Chemistry*, Mr Harold Burton (Guy's Hospital Medical School) and Mr C W Shoppee, an external student *D Sc in Soil Bacteriology*, Mr H G Thornton (Rothamsted Experimental Station) *D Sc (Engineering)*, Mr C H M Jenkins (Imperial College—Royal School of Mines) and Mr Burrows Moore (King's College) *D Sc in Botany* Mr C R Darlington, an external student

Prof J K Catterson Smith has been appointed as from Aug 1 to the University chair of electrical engineering tenable at King's College Prof Catterson Smith was educated at the City of London School, the South Western Polytechnic, and the University of Birmingham Since 1923 he has been professor and head of the Department of Electrical Engineering at the Indian Institute of Science, Bangalore, of which he has also officiated as director

THE International Committee and the Sub Committees on Intellectual Co operation of the League of Nations will be holding meetings in Geneva during the whole of the month of July The sub committee of experts on the instruction of youth in the aims and objects of the League of Nations meets on July 3 It is due to the past labours of this committee that so much educational work (including direct teaching) for the League is going forward in various countries Two 'common chapters' have been produced by the Secretariat at Geneva These are intended to form the core of national text books on the subject and will "probably assume a different form in various countries" The British volume is to be produced under the auspices of the newly formed British National Committee on Intellectual Co operation, to avoid its being of too official a character After the other sub committees have completed their labours the thirteenth plenary meeting of the International Committee will take place on July 23 Its principal business will be the discussion of the report of the committee of inquiry into the working of intellectual co operation which met at Easter Considerable changes of organisation are foreshadowed, especially in regard to the Paris Institute The number of subjects to be dealt with under the heading of intellectual co operation have been considerably 'rationalised' It is hoped that by a greater concentration of effort, more concrete results will follow

Historic Natural Events

June 30, 1908 The Siberian Meteorite —A great meteorite fell in the upper basin of the Podkamennaia Tugunska River, Siberia, about 60° N, 71° E The place of fall, as described in 1927, had the appearance of a huge crater, several kilometres across, surrounded by an amphitheatre of mountain chains and peaks The area formerly forest, was completely wrecked, lines of stripped tree trunks without branches or bark lay struck to the ground in parallel rows, their tops away from the centre of fall of the meteorite Even where the pines were standing they were usually trunkless and branchless, and showed signs of having been burnt over an area tens of kilometres across More than a thousand reindeer were killed, some disappeared entirely, burnt remains of others were found The burning was not due to ordinary fire but probably to the cloud of incandescent gases which accompanied the meteorite The force of the impact threw the ground into flat folds, but the greatest damage was done by the air wave At a distance of nearly 400 miles the noise and vibration resembled that of a nearby explosion The air wave probably passed completely round the world, it was clearly shown on micro barographs in England, where its cause was at the time unknown, and it aroused great interest It was described as a succession of four undulations, commencing with a range of about five thousandths of an inch lasting about a quarter of an hour, and then violently interrupted by a sudden, though slight, explosive disturbance which set up different and much faster oscillations for a similar interval

June 30, 1908 Brilliant Sky Glows —In central and western Europe and the British Isles, brilliant sky glows were observed on the night of June 30 and on several succeeding nights, especially July 1 The whole northern part of the sky, up to an elevation of about 45°, was suffused with a reddish hue, varying from pink to Indian red, while in the east the sky was a pale green At midnight fairly small print could be read out of doors It remained as light in the south of England as is normal in the north of Scotland at this season There was no flickering or other indication of aurora, and the phenomenon appears to have been an abnormal prolongation of twilight throughout the night, there is little doubt that, as suggested by Mr Spencer Russell, it was caused by the 'cosmic dust' resulting from the fall of the meteorite described above

June 30, 1926 Floods in Yugoslavia —Heavy floods occurred in many parts of Europe towards the end of June and during July, and in Yugoslavia they were very extensive and prolonged On June 30 and July 1 large areas in southern Serbia and Hertzegovina were under water, Nish, Veles, and Pirot being flooded and ripe crops destroyed Parts of Belgrade were inundated by the Danube and Save About a fortnight later further heavy rain and hail occurred, and the Danube and Save again overflowed, while in Rugovo, Montenegro, 40 people were killed by hail Many dams burst their banks and numerous bridges were destroyed Damage to the extent of about £10,000,000 was done

July 2, 1893 Cloudburst in Cheviots —A hill in the Cheviots, known as Bloody Bush Edge, was visited by a waterspout or cloudburst The day was oppressive and about 10 A M heavy clouds gathered These broke about 1 P M and 'the whole hill and parts of the adjoining hills were covered with a sheet of water" (' British Rainfall ") The peat which forms the surface of the hill was ploughed up to a depth of about five feet, and the rocks beneath laid bare over a space of 30 40 acres The River Breamish rose forty feet in sudden flood, swept away its bridges and destroyed long stretches of roadway

July 3, 875 Cloudburst in Saxony —In Saxony occurred a cloud burst of great violence, Ascheubrunn, a place remote from all water, being washed away with all inhabitants and buildings

July 3, 1863 Hailstorm at Clermont-Ferrand —The day was exceedingly hot, and by 3 P M the sky was covered by an enormous nimbus cloud, with flashes of lightning in quick succession About 6 P M a cloud approached rapidly from the west, at a height estimated as 5000 feet It resembled a huge net in form, the portion represented by the netting showed violent agitation and soon after the arrival of the cloud there was a heavy hailstorm lasting about five minutes, the hailstones being as large as nuts During the fall of the hail there was no wind The hail caused considerable damage wherever it fell, and M Lecoq, who saw the storm and described it in the *Comptes rendus*, stated that the damage was limited to small patches, which were surrounded by undamaged zones, forming a network the meshes of which were irregular but roughly 60 100 metres apart The distribution of the hail corresponded with the form of the cloud

July 3, 1892 Floods at Langtoft —A heavy black cloud with three pendants burst over the hills west of Langtoft in Yorkshire, and a great volume of water flowed into the valley, cutting two deep channels in the chalk The village was flooded to a depth of eight feet, and great damage was done On the same day heavy rain fell near Driffield, and this, added to the water from Langtoft, caused further floods

July 5-6, 1911 Low Antarctic Temperature —During Scott's last Antarctic expedition, a party travelling by sledge from Cape Evans to Cape Crozier met with very low temperatures as soon as they reached the Barrier For more than a week the thermometer was below −60° F, on the night of July 4 5 the minimum temperature was −71° F, and on that of July 5 6, −77° F Although the air was comparatively still, little puffs of wind came eddying across the snow plain with blighting effect, and the party felt the cold severely in their canvas tent

Societies and Academies

LONDON

Royal Society, June 19 —**H R Robinson** and **C L Young** New results of the magnetic spectroscopy of X ray electrons New measurements are given of the energies and intensities of the secondary, tertiary, cathode rays ejected by silver K radiations from a number of elements The results are discussed in their relation to current theories of the interaction of X rays and matter and of the X ray term structure

Royal Meteorological Society, June 18 —**C E P Brooks** and **S T A Mirrlees** Irregularities in the Annual Variation of Temperature in London The late Dr A Buchan enumerated six cold and three warm spells which recurred about the same dates in each year in Scotland in the 1860's To find whether these or similar spells occurred also in London, averages of temperature at Kew Observatory were found for each of the periods 1871 to 1900 and 1901 to 1929, and were combined into five day means a "spell" being defined as a period of five days The details of the curves of annual variation obtained in this way were almost completely different in the two periods, and do not give the slightest support to the idea that there is any abiding tendency for any part of the year to be either cold or warm for the season In particular, the famous 'Buchan cold periods' are abnormally warm as often as they are abnormally cold The nearest approach to a regular cool period occurs in summer when the annual rise of temperature ceases towards the end of July and gives place to a period of variable temperature which continues until the autumn fall sets in about the middle of August, but none of these oscillations occurs with sufficient regularity to enable any special dates to be picked out as definite warm or cold periods —**C E P Brooks** The Climate of the first half of the Eighteenth Century There has been no appreciable change of climate since 1750, but there is much evidence that the first half of the eighteenth century was abnormally dry in western Europe Rainfall figures are discussed for 29 places, and the average deficiency of rainfall is calculated as 7 per cent in England, 15 per cent in France, and 9 per cent in Russia and Sweden South westerly winds were less frequent than now and north westerly winds more frequent, the area of low pressure near Iceland was therefore probably less intense than at present The deficiency of rain was greatest in the south of France, while Italy and Tunis were wetter than now, suggesting that the stormy area in the Gulf of Lyons was highly developed The inquiry is extended to other parts of the world, the slow growth of the 'Big trees' shows that rainfall was slight in western U S A, and the Lake of Mexico was at a low level, but the Caspian Sea and the Nile floods were high and there were many floods in China All these facts agree that the general atmospheric circulation, which governs the rainfall of western Europe and California, was weak, the southerly monsoons of Abyssinia and China, which override the general circulation, were abnormally strong and brought heavy rainfall to those countries

PARIS

Academy of Sciences, May 12 —**Ernest Esclangon** The determination of the position and elements of an object (planet or comet) by three observations corresponding to a small arc of the orbit A mathematical discussion of a method which assumes only that the arc described by the object round the sun during the interval of the observations is a small angle, and this without any hypothesis as to the arc described by the earth in the same interval —**Gabriel Bertrand** and **Mlle Y Beauzemont** The variations of the content in zinc of animals with age the influence of a milk diet Earlier work by Bertrand and Vladesco showed that in mammals the proportion of zinc present is at a maximum at birth, gradually diminished during the period of milk feeding the milk being very poor in zinc, and increases again after weaning Several American workers having recently published results which appear to contradict these conclusions, a critical discussion of the American work is given, and fresh experimental evidence produced supporting the authors' original conclusions —**André Blondel** The application of the mutual impedances to the study of the regimes of networks out of equilibrium —**Maurice Lugeon** The origin of granite In opposition to the view that granitic rocks are due to igneous intrusion from below, it is suggested that during folding movements the mechanical energy has been transformed into its heat equivalent, and the formation of granitic rocks is due to this enormous liberation of heat —Charles Maurain was elected a member of the Section of Astronomy in the place of the late H Andoyer —**G Vrançeanu** The groups of applicability of non holonome varieties —**Paul Alexandroff** The theory of dimension —**L Pontrjagin** A fundamental hypothesis of the theory of dimension —**E D Pompéiu** A functional equation which occurs in a problem of average —**J Dieudonné** The circles of multivalence of limited functions —**Georges Valiron** A class of functional equations **L Kantorovitch** and **E Livenson** The projective ensembles of M Lusin —**Henri Poncin** The flow of heavy fluids —**Emile Merlin** A very general case of the motion of a heterogeneous perfect fluid in rotation, presenting striæ in the form of spirals —**Henri Marcelet** The spectrographic analysis of the fluorescences of some vegetable oils observed under the ultra violet rays As ocular comparisons of fluorescent colours are rather uncertain, a spectrographic method has been used Both the emission and absorption spectra were studied and these were found to be quite different Some technical applications are suggested **Swyngedauw** The theory of balanced dynamos utilised for the measurement of the losses in pulley belts —**S Rosenblum** The fine structure of the magnetic spectrum of the α rays The measurements were made with the large electromagnet of the Academy of Sciences (Bellevue) with modified arrangements giving a higher order of accuracy than in the first experiments The velocities are referred to the velocity of the α radiation of thorium C as unity, and have an accuracy of one part in a thousand —**E Carrière** and **Janssens** The determination of fluorine as calcium fluoride Improvements on a method previously described —**Travers** and **Avenet** The estimation of thiocyanates in coke oven effluents —**Lespieau** Phenyltrimethylene This was obtained in an impure state by the action of zinc on the compound CH_2Br CH_2 $CHBr$ C_6H_5 Purification was effected by cautious treatment with a weak solution of potassium permanganate Its physical and chemical properties are compared with those of allylbenzene and propenylbenzene —**A Seyewetz** and **Brissaud** Water of crystallisation in mineral and organic compounds —**R Clogne, Mlle A Courtois,** and **Cazala** The proportion of arsenic in the wells of Choussy de La Bourboule and the fixation of this arsenic in the organism The proportion of arsenic found varied according to the season between 5 8 and 6 5 mgm per litre Tadpoles were readily acclimatised to this water The amount of arsenic absorbed increased the proportion found in the tadpoles by more than 70 per cent —**Paul Becquerel** The latent

life of fern spores in a vacuum at the temperature of liquid helium The spores, previously dried for six months over barium oxide, were cooled for a period of eleven hours to $-270°$ C, in a bath of liquid helium No difference between the spores thus exposed and those kept at the ordinary temperature could be observed, the germinating power and appearance and ... of the prothallus being similar in both cases ...tu and L Maume The comparative chemi... ...tion of vine leaves removed from different ...ights of the branches J Chaussin and E Blan...rd The physico chemical regulation in the internal medium of some agricultural plants —**Robert Lemesle** Observations relating to *Fusarium anthophilum*, a parasite of *Scabiosa succisa* —**Louis Bounoure** The presence of distinct germinal cells in the blastula of the reddish brown frog —**J de Lépiney** The biology of the pilgrim cricket (*Schistocerca gregaria*) —**L Doljanski, J J Trillat, and Lecomte du Noüy** The action of the X rays on cultures of tissues *in vitro* Previous work on the effect of X rays on tissue cultures *in vitro* has tended to prove exceptional resistance of the latter The author considers that these results were due to faulty technique The experiments described show that the lethal dose is reached after five minutes irradiation —**Raoul M May** Water and the phosphorus combinations of the nerve in the course of degenerescence **Edouard Chatton, André Lwoff, and Mme Marguerite Lwoff** *Phoretophyra nebaliæ* and the interpretation of the evolutive cycle of the ciliated Fœttingeridea —**Radu Codreanu** The internal phase of the evolutive cycle of two forms of *Ophryoglena*, endoparasitic Infusoria of the larvæ of ephemera —**G Ramon** The reciprocal relations of the diphtheria antitoxin and the antigen (toxin and anatoxin)

Official Publications Received

BRITISH

Proceedings of the Royal Society of Victoria Vol 42 (New Series) Part 2 Pp 69 256+plates 2 22 (Melbourne)

Canada Department of Mines Mines Branch Abrasives Products of Canada Technology and Application Part 4 Artificial Abrasives and Manufactured Abrasive Products and their Uses By V L Eardley Wilmot (No 699) Pp vii+144 (19 plates) (Ottawa F A Acland) 20 cents

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1227 (Ae 382) The Wing Flutter of Biplanes By W J Duncan (T 2831) Pp. 60 3s net No 1277 (Ae 423) Stability Derivatives of the Bristol Fighter By Dr A S Halliday (T 2854) Pp. 14+14 plates 1s net No 1294 (Ae 443) Centre of Pressure Travel of Symmetrical Section at Small Incidence By F B Bradfield (T 2892) Pp. 9+7 plates 9d net. (London H M Stationery Office)

Department of Scientific and Industrial Research Forest Products Research Bulletin No 5 The Moisture Content of Wood with Special Reference to Furniture Manufacture By S T C Stillwell Pp vi+27 (London H M Stationery Office) 2s net

The Hannah Dairy Research Institute Annual Report for the Year ending 31st March 1930 Pp 16 (Glasgow The University)

Proceedings of the Royal Society Series A Vol 127, No A806 June 2 Pp 479 712+xxvi (London Harrison and Sons, Ltd) 12s

Department of Scientific and Industrial Research Report of the Food Investigation Board for the Year 1929 Pp vi+146 (London H M Stationery Office) 2s. 6d net

British Antarctic Expedition, 1907-1909 Reports on the Scientific Investigations Meteorology By Dr Edward Kitson Pp 188 (Melbourne Council for Scientific and Industrial Research London Official Secretary, Australia House) 8s

The Journal of the National Institute of Agricultural Botany Vol 2 No 3 Pp 177 308 (Cambridge W Heffer and Sons Ltd) 2s 6d net

Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich read at the Annual Visitation of the Royal Observatory 1930, June 7 Pp 19 (Greenwich)

Department of the Interior Natural Resources Intelligence Service The Province of New Brunswick, Canada its Natural Resources and Development By L O Thomas Pp 168 (Ottawa Natural Development Bureau Department of the Interior) Free

India Meteorological Department Scientific Notes, Vol 2, No 12 The Association of the Mid Monsoon Indian Rainfall with Pressure Distribution over the Globe By Rao Saheb Mukund V Unakar Pp. 13 19+4 plates (Calcutta Government of India Central Publication Branch) 10 annas 1s

Annual Report of the Calcutta School of Tropical Medicine, Institute of Hygiene and the Carmichael Hospital for Tropical Diseases, 1929 Pp 116 (Calcutta Bengal Government Press)

Home Office Criminal Statistics England and Wales 1928 Statistics relating to Crime, Criminal Proceedings and Coroners Investigations for the Year 1928. (Cmd 3581) Pp lxix+197 (London H M Stationery Office) 4s. net.

Miscellaneous Publications of the Royal Alfred Observatory No 10 The Cyclone Season 1928–1929 at Mauritius By R A. Watson Pp 4+30 charts (Mauritius.)

FOREIGN

U S Department of Agriculture Leaflet No 60 Porcupine Control in the Western States By Ira N Gabrielson and E E Horn Pp 8 5 cents Miscellaneous Publication No 71 Weather Forecasting from Synoptic Charts By Alfred Judson Henry Pp 80 20 cents (Washington D C Government Printing Office)

Memoires de la Société de Physique et d Histoire Naturelle de Genève Vol 40 Fascicule 4 Table générale des matières contenues dans les volumes 1 40 des Mémoires Pp 485 500 (Genève Georg et Cie) 5 francs

Cornell University Agricultural Experiment Station Ithaca New York Bulletin 499 The Effect of Dusting Sulfur upon the Germination of the Pollen and the Set of Fruit of the Apple By L H MacDaniels and J R Furr Pp 13+1 plate Bulletin 500 Legumes as a Source of Available Nitrogen in Crop Rotations By T L Lyon Pp 22 (Ithaca N Y)

Proceedings of the United States National Museum Vol 77 Art 11 The Herpetological Collections made by Dr Hugh M Smith in Siam from 1923 to 1929 By Doris M Cochran (No 2834) Pp 39 (Washington D C Government Printing Office)

Methods and Problems of Medical Education (Seventeenth Series) Pp iv+279 (New York The Rockefeller Foundation)

Proceedings of the Imperial Academy Vol 6 No 3 March Pp ix xi+93 129 Vol 6 No 4 April Pp viii xiv+131 185 Supplement to Vol 6 A Concordance to the History of Kirishitan Missions (Catholic Missions in Japan in the Sixteenth and Seventeenth Centuries) Compiled by Masaharu Anesaki Pp iii+225 (Tokyo)

United States Department of Agriculture Miscellaneous Publication No 74 An Annotated List of the Important North American Forest Insects Compiled by F C Craighead and William Middleton Pp 31 (Washington, D C Government Printing Office) 10 cents

Japanese Journal of Astronomy and Geophysics Transactions and Abstracts Vol 7 No 3 Pp iv+83 14 +19 44+23 plates (Tokyo National Research Council of Japan)

CATALOGUES

Bulletin No 2 Spectrum Analysis Pp 93 (London Adam Hilger, Ltd)

Acetylcholine B D H in the Treatment of Raynaud's Disease, Arteritis Arterial Hypertension and similar Complaints Pp 8 (London The British Drug Houses, Ltd)

English and Foreign Literature a Collection of Miscellaneous Books (No 30) Pp 108 (Newcastle on Tyne William H Robinson)

Photography Simplified Development Pp 12 (London Burroughs Wellcome and Co)

Diary of Societies

FRIDAY, JUNE 27

ROYAL SOCIETY OF MEDICINE (Otology Section) (at Nottingham) at 2 — Papers by Dr M Evans Prof G Guild Dr Dansham, and L Yates Discussion on the Proceedings of the Committee for the Consideration of Hearing Tests

SATURDAY, JUNE 28

ROYAL SOCIETY OF MEDICINE (Orthopædics Section) (at St Vincent's Orthopædic Hospital Eastcote near Pinner) at 3

ROYAL SOCIETY OF MEDICINE (Otology Section) (at Nottingham) (continued)

TUESDAY, JULY 1

ROYAL SOCIETY OF MEDICINE at 4 30 —Annual General Meeting

FRIDAY, JULY 4

GEOLOGISTS ASSOCIATION (at University College), at 7 30 —Dr C T Trechmann The Relation of the Permian and Trias in North East England —J J Hartley The Volcanic and other Igneous Rocks of Great and Little Langdale Westmorland —*Paper to be taken as read* — F Jessop The Agates and Cherts of Derbyshire with a Brief Account of the History of the Lower Carboniferous Limestone of the Peak District.

ASSOCIATION OF ECONOMIC BIOLOGISTS (at National Institute for Research in Dairying, Shinfield, near Reading)

CONGRESS.

JUNE 21 TO 28.

ROYAL SANITARY INSTITUTE (at Margate,

Friday, *June* 27, at 10 A M —Meetings of Sections and Conferences
C —Maternity and Child Welfare (Including School Hygiene)
E —Hygiene in Industry
F —Veterinary Hygiene
II —Representatives of Port Sanitary Authorities
III —National Health Insurance Services.

SUMMER MEETING.

JUNE 30 TO JULY 4

INSTITUTION OF MECHANICAL ENGINEERS (at Bristol).